**A DISSERTATION ON**

# TRANSCEREBELLAR DIAMETER

# A NEW AND ACCURATE SONOGRAPHIC PARAMETER FOR PREDICTING GESTATIONAL AGE

**A Dissertation submitted in partial fulfillment of the requirements for the degree of**

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# INSTITUTIONAL ETHICAL COMMITTEE, STANLEY MEDICAL COLLEGE, CHENNAI-3

Title of the Work : Transcerebellar Diameter - A New and accurate sonographic parameter for predicting gestational age

Principal Investigator : Dr.D.Geetha
Designation : PG in MD(O&G),
Department : O&G

The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 15.04.2010 at the Modernised Seminar Hall, Stanley Medical College, Chennai-1 at 2PM

The members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

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SECRETARY
IEC, SMC, CHENNAI

MEMBER SECRETARY
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CHENNAI-600 001.

# CERTIFICATE

This is to certify that the dissertation titled, **"TRANSCEREBELLAR DIAMETER - A NEW AND ACCURATE SONOGRAPHIC PARAMETER FOR PREDICTING GESTATIONAL AGE"** is an original work done by **Dr.D.GEETHA**, Post Graduate Student, Govt. RSRM Lying in Hospital attached to Stanley Medical College, Chennai-1, under my supervision and guidance.

**Dr.C.VAMSADHARA, M.D.,Ph.D.,**
Dean
Stanley Medical College
Chennai-1

**Dr.SHANTHI DINAKARAN, M.D., D.G.O.**
Superintendent,
Govt. RSRM Lying in Hospital,
Stanley Medical College
Chennai -1

Place: Chennai-1
Date :

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# CONTENTS

# Introduction

# INTRODUCTION

"Research is to see what everybody else has seen and to think what nobody else has thought."

**ALBERT GYORGYI**

Ultrasound is the primary imaging modality in obstetrics over the last three decades. Ultrasonography is a procedure which can be performed and repeated without risk to the mother or fetus. With better awareness and education, the healthcare professionals as well as the parents are interested in ensuring the best, even for the unborn child. In this era of "survival of the fittest" it is a right of every parent to know about the fetal well being. Ultrasound has become clinically and medico-ethically an important investigation in detecting intrauterine fetal anomalies and gestational age assessment.

The advent of ultrasound has allowed a more direct means of assessing fetal structures and development of various organs. In the past, gestational age has been established by a combination of the historical information and physical examination. Predictions were passed based on menstrual history, maternal sensation of fetal movement, assessment of uterine size by bimanual examination in the first trimester, initial

detection of fetal hearttones by Doppler and uterine fundal height measurement[1-6].

However it has been reported that, even in best known cases the menstrual history and fundal height measurement are also fraught with error [7]. Timed ovulation and invitro fertilisation with known date of conception are expected to estimate the gestational age accurately. The hazards associated with the radiology have since been overcome by the use of ultrasound techniques.

Fetal biometry by ultrasound assessment has become the major method of both reassuring gestational age, growth and accuracy. In 1961, Donald and Brown described the ultrasonic technologies for determining the fetal biparietal diameter. Subsequent workers have established that this is the safest, most convenient and most accurate method of antenatal cephalometry, although biparietal diameter has been a standard parameter, fetal position occasionally affects BPD measurement. Biparietal measurement obtained in the conventional plane is altered in conditions where extrinsic pressures may deform skull like oligohydramnios, breech, multiple pregnancy and uterine anomalies.

Cerebellum is a suprasegmental portion of the brain located within the posterior cranial fossa. The fetal cerebellum can be visualized sonographically as early as 10 weeks of gestation. From the second trimester, it grows rapidly. However, as the pregnancy advances, the growth curve tends to flatten.

The cerebellum is relatively resistant to disturbances in fetal growth and cranial deformation. In the embryo, the cerebellum appears at the end of the fifth week as a swelling over-riding the fourth ventricle. By 6 weeks, the flocculonodular lobes develop, followed by bilateral growth of the hemispheres which eventually meet in the midline. The folia of the vermis begin to develop by 13 weeks and the lamellae are evident by 15 weeks paralleling the growth of the cerebellar hemispheres [8].

Cerebellum is located in the posterior cranial fossa wedged between the occipital bone infero-posteriorly and dense petrous ridges laterally, it should be able to withstand deformation by extrinsic pressure (Mcleary et al : 1984) including fetal malposition, breech presentation or oligohydramnios.

The transverse cerebellar diameter can better predict gestational age in cases of variations of the fetal head shape such as dolichocephaly and brachycephaly [9] or even when the fetus is in posterior position.

Most cases of intrauterine growth restriction showed no changes. Cerebellar diameter has become important since it is a more reliable measurement in conditions of growth restrictions (Reece et al 1987). Appearance of cerebellum also acts as a pointer for several posterior cranial fossa abnormalities.

It is imperative to understand that no single ultrasound measurement will precisely determine gestational age in every case. A number of investigators have mentioned whether a single determination is adequate to assess gestational age. Even the best prepared studies have reported a range of error in the predictive ability of one method or another to determine fetal age.

Most investigators agree that the benefits of the single determination are greatest in the second trimester. After this time the use of multiple parameters have been shown to increase efficacy. Some investigators have suggested that serial BPD measurements will improve

the accuracy of dating techniques. BPD remains a commonly measured parameter for the following reasons:

1. Improved resolution now allows defined end points of measurements and observations of intracranial landmarks.

2. A large database exist for correlating BPD with gestational age and

3. The technique is easy to apply & can be performed in most patients.

**FETAL BIOMETRY**

After proper history taking and doing survey ( see for number, position, viability, localization of the placenta and amniotic fluid) third step is fetal biometry. It is done **to assess fetal age and "size for the age"**. Though a large number of biometric parameters have been described, the minimum parameters that must be measured are BPD/OFD/HC/AC/FL. It is also, wise to include transcerebellar diameter (TCD) in the biometric protocol [10, 11].

For assigning the gestational age of the fetus the following steps are followed.

1. Calculate GA and EDD by LMP

2. Calculate GA by biometric parameters

3. Decide whether the EDD is to be corrected according to biometry. This is done if there is a significant discrepancy between the menstrual age and the ultrasound age.

**ACCURACY OF VARIOUS FETAL BIOMETRIC ULTRASONOGRPHIC PARAMETERS**

| SL. NO. | THE PARAMETER | % ACCURACY |
|---|---|---|
| 1 | Biparietal diameter (BPD) | 82% |
| 2 | Femur length ( FL) | 88% |
| 3 | Head Circumference ( HC) | 85% |
| 4 | Abdominal circumference (AC) | 78% |
| 5 | Transcerebellar diameter (TCD) | 92% |

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The fetal cerebellum can be visualized sonographically as early as 10 weeks of gestation. From the second trimester, it grows rapidly. However, as the pregnancy advances, the growth curve tends to flatten. Observation from these studies led to the present work on transcerebellar diameter to assess fetal gestational age. In India there is an increased incidence of congenital malformations and intrauterine growth restriction, owing to consanguinous marriage and illiteracy. Assessment of fetal gestation using transcerebellar diameter also reveals congenital malformations of the posterior cranial fossa.

# Aim of the Study

The aim of the present study is

1) To prospectively evaluate the application and accuracy of transcerebellar diameter measurement in determining the gestational age of the fetus in second trimester in patients with known and unknown dates and

2) To compare it with conventional biparietal diameter and femur length.

# Review of Literature

# REVIEW OF LITERATURE

"Everything has been thought of before but the problem is to think of it again:

**-GOETHE**

Ultrasound is defined as the sound above the range of human hearing that is above the frequency of 20,000 Hertz - Normal human hearing frequency range is between 20 Hz - 20,000 Hz. Bats, dolphins and dogs can hear ultrasound. Bats and dolphins can produce, emit and receive back the reflected ultrasound and thereby move around in the dark without hitting into rock and trees.

## HISTORICAL BACKGROUND

History is bunk -.but we can learn from it

**- HENRY FORD**

Ultrasound was first demonstrated by Spellanizine in 1794 on bats. Langria of France first used it for detection and destruction of submarines during first World War in 1915. It was named SONAR - Sound - Navigation and ranging. It was used to detect flaw in metals and

metallic structures like bridges, beams, etc. The first medical use was done by Dussik in 1930 for visualization of cerebral ventricles. But his technique was very crude.

**Professor Ian Donald** of Glasgow (1960) reintroduced with much modifications and he is called as the "**Father of Modern Ultrasound**". He improved the contact between ultrasound source and the patients body by placing the patient in water bath and finally by smearing the skin with oil or jelly.

He insisted on 'full bladder" technique because ultrasound transverses best through fluid medium. The fetus stands as an ideal subject for ultrasound investigation as it remains surrounded by water all the time.

Ultrasonography as a technique for determining the foetal gestational age was introduced in the nineteen fifties. In a surprisingly short span of time, development and improvisations in newer technology and research methodology has led to a mind-boggling improvement in assessment of foetal gestation. **Donald the Brown (1961**) described an ultrasonic technique for determining the foetal **biparietal diameter**.

Early limitation observed by Willocks (1963) an error incidence of 0.5 cm or more and Durkan and Rusoo (1966) - discrepancy in antenatal ultrasonic and postnatal caliper measurements of biparietal diameter to be 0.5 cm or more were further confounded by the fact that measurements could be made only on a palpable foetal head. Subsequent improvements in ultrasonography and untiring efforts of workers established a safe, convenient and accurate method of antenatal measurement of foetal parameters.

Stuart Campbell (1968) established a new method in which A scan and B scan techniques were used to overcome limitations. Further contributions and references from Donald and Adbulla (1967) and Willocks et.al (1967) brought to use the system of unidimensional A scan and Plan Position Indication (PPI) or B scan which gives a two-dimensional picture with outlines of anatomical structures.

In the seventies, Altman (1972) and Altman and Bayer (1978) studied in detail the microstructure of cerebellar system. On-going parallel studies on Cerebellum by Angaut and Brodal (1967), Brown (1949), Burne et.al. (1978), Colin (1980) and others, gained insights into cerebellar cells, circuits and networks.

Nikolo et al (1991) studied the echographic measurement of fetal transverse cerebellar diameter in the second trimester as a nonstandard method for determining the gestational age.

Campbell et al (1991) observed that the ratio of transverse cerebellar diameter and abdominal circumference is a gestational age independent parameter, and can be used to assess fetal growth.

**TRANS CEREBELLAR DIAMETER AND POSTERIOR CRANIAL FOSSA LESIONS:**

Cerebellar anomalies were also sought and failure to demonstrate the cerebellum was considered as a clue to the presence of myelodysplasia, Arnold-Chiari malformation or Dandy-Walker cyst. Dandy and Blackfan (1914) studied the lesions associated with the posterior cranial fossa. Dandy (1921) deviced a method for diagnosis and treatment of hydrocephalus due to occlusion of foramen of Magendie. Interesting clinical and anatomical findings related to atresia of foramina of Magendie and Luschka were reported by Brodal, Hanssen et. al in 1959.

Dempsey and Koch (1981) added vital informations on in-utero diagnosis of Dandy - Walker Syndrome. It was Yousefzadeh and

Naidich (1985) who correlated the ultrasound images of posterior cranial fossa with gross and myelin-stained sections of human brain. Their study illuminated the nature of structures displayed sonographically, thanks to the improvements in ultrasound. Smith, Johansson, et.al. (1986) visualised, foetal cerebellum throughout second trimester ultrasonographically and devised a technique for measuring the transverse, anteroposterior cerebellar diameters and measurement of the cisterna magna. Nomograms for these recordings showed good correlations against gestational age and narrow confidence limits for transverse cerebellar diameter. Reece, Goldstein, Pilu and Hobbins 1987, utilized these parameters in assessment of growth stress on cerebellum.

Pilu, Romero, Jeanty, Burdine and Hobbins (1987) evaluated the use of ultrasound in demonstrating the anatomy of foetal posterior cranial fossa of various gestational ages ranging from 15-40 weeks. Further verification from anatomic dissection of brains of still born premature infants, helped interpretation of ultrasound parameters obtained.

Pilu et.al (1988) further proceeded to find out decreased cerebellar size, failure to visualize cerebellum and obliterated cisterna

magna in cases of spina bifida specifically. Duchatel, Menesson and Berseneff (1989) presented a study based on ultrasound measurements for the growth of foetal cerebellum from the 17th -39th week of amenorrhoea. Regular growth of cerebellum seemed to be independent of other biometric parameters and also of the population studied.

Bronshtein et.al (1998) explained the possibility of benign, transient, isolated large fourth ventricle in early pregnancy. This is significant in diagnosing early cases of hydrocephalus.

**TRANSCEREBELLAR DIAMETER AND LARGE FOR GESTATIONAL AGE FETUSES:**

Hill, Fries et al. (1990) evaluated the significance of transcerebellar diameter in large for gestational age fetuses. Significant over estimations in gestational age were obtained in head circumference and abdominal circumference measurements but not in transcerebellar diameter. Montenogro, Leite (1989) found it easier to obtain transcerebellar diameter than other biometric parameters even in occiput posterior positions during early months of pregnancy.

## TRANSCEREBELLAR DIAMETER AND GENETIC DEFECTS

Marchese, Hill et.al (1991) also studied the effect of **Trisomy 18** on transverse cerebellar diameter [12]. Interestingly, it was found to be decreased consistent with growth restriction and intrinsic central nervous system abnormalities.

Rotmensch et. al (1997) studied fetal cerebellar diameter in down syndrome and found that the cerebellar diameters in **Down syndrome** fetuses [13] were smaller than in normal controls at all gestational ages, and is sonographically recognizable in II trimester.

## TRANSCEREBELLAR DIAMETER AND GROWTH RESTRICTION:

Fetal cerebellar growth is unaffected by intrauterine growth restriction and transcerebellar diameter may serve as an independent and reliable correlate of gestational age against which potential deviations of growth may be compared was observed by Reece et al (1987) [14,15].

Preliminary studies on cerebellum in foetuses and new born infant as a prognostic index were done by Segura, Lowenberg et.al. (1992). Guan, Chung et.al. (1992) surveyed foetal growth and foetal cerebellar

transverse diameter by ultrasound. It was found to have clinical diagnostic value in symmetric intra-uterine growth restriction and along with abdominal circumference, helped in differentiating the types of growth- restricted foetuses. It was Huang and Liu (1993) who studied the differential growth of the cerebellar vermis in normal and small-for-gestational age foetuses. New revelations in the form of reduced cerebellar vermian area has been brought to light. This was further reported only in 38-41 weeks subgroup of foetuses. Late gestational reduction of cerebellar vermis area is documented as a measure of growth restriction.

Hill et.al (1990) in his study of small for gestational age fetuses observed that the transcerebellar diameter cannot be used to assess the gestational age.

Lee et. al (1991) in his study of cerebellar growth and growth restriction observed that the transcerebellar diameter can be used to predict the gestational age in fetuses with asymmetric intrauterine growth restriction but caution is warrented when using it to predict the gestational age of fetuses affected by symmetric intrauterine growth restriction.

Meyer et.al (1994) observed in his study that the fetal transcerebellar diameter / abdominal circumference ratio is an accurate gestational age independent method of identifying the small for gestational age fetuses.

Tongsong et. al (1999) in a study of intrauterine growth restriction by fetal transverse cerebellar diameter / abdominal circumference ratio found it a useful parameter in the antenatal diagnosis of IUGR especially in pregnancy with uncertain gestational age.

**TRANSVAGINAL STUDIES OF CEREBELLUM**

What was a nightmare was converted to reality by the studies of

Blaas, Eik, Kiserud and Hellevik in 1995, by studying the early development of the hind brain from 7-12 weeks of gestations by the introduction of a transvaginal probe. Guariglia, Rosati (1996) added to the advantage by visualising foetal growth earlier upto 4 weeks by transvaginal ultrasound, than with traditional abdominal ultrasound.

This adds to the fact that some foetal malformations can be detected earlier. Clinically proved cerebellar hypoplasia and frontal lobe shorterning were studied by Persutte, Coury and Hobbins (1997).

Correlative values obtained using these parameters, is found to be a useful tool in assessing relative effect of clinical syndromes on structural neuroanatomy.

**TRANSCEREBELLAR DIAMETER AND TWINS**

Shimizu et. al (1992) evaluated the significance of transverse cerebellar diameter in twin pregnancies and found that there was no significant difference in transverse cerebellar measurements.

(a) Between normal singleton and twin gestations

(b) In each twin pair

(c) Unaffected by Chorionicity or discordancy

(d) Predicated gestational age by transverse cerebellar diameter nomogram for singleton provided satisfactory correlation for twins. Letteieri et. al (1992) in the study of twin pregnancies and intra uterine growth restriction observed that the cerebellar growth may be affected by intrauterine growth restriction in twins.

Goldstein et. al (1995) evaluated the growth of cerebellum in normal and growth restricted fetuses of multiple gestations. Their data

confirmed the relative preservation of normal cerebellar growth in growth restricted fetuses and a similar rate of growth in singleton and multifetal gestations. The transverse cerebellar diameter represents an independent biometric parameter that can be used in both singleton and multifetal pregnancies to asses normal and deviant fetal growth.

## VARIOUS TECHNIQUES OF SCANNING THE CEREBELLUM

Kofinas et. al (1992) compared the fetal cerebellar measurements by two different techniques and concluded that the coronal cerebellar diameter is reproducible and accurate and can be used instead of transverse cerebellar diameter, when the latter is not obtainable because of fetal position.

Chang et. al (2000) studied the fetal cerebellar transverse diameter and cerebellar antero-posterior diameter using three dimensional ultrasound and showed that 3-D Ultrasound is superior to 2-D Ultrasound in the reproducibility test of fetal cerebellar dimension.

## FETAL CEREBELLUM AND MAGNETIC RESONANCE IMAGING

The zenith of the study of fetal cerebellar development is reached with the magnetic resonance template studies of fetal cerebellar development. Chong, Babcook, Pang and Ellis (1997) defined central nervous system malformations better with high-resolution magnetic resonance imaging. The interpretations of their study is beyond the scope of the present study.

Transcerebellar diameter has also been used as a reference in studies of foetal nose width (Ben Ami, Weiner, Perlitz and Shaler 1998).

Ranzini et. al (1998) demonstrated prenatal sonographic appearance of haernorrhagic cerebellar infraction. Morphological forms and localization of microglial cells in developing human cerebellum was studied by maslinka et. al (1998).

Valuable details have been collected from rare cases - a case of acrania, associated with medulloblastoma, agenesis of cerebellum and nasoshizis at 20th gestational week by sonography (Asai et. al. 1998) and cerebellar-top-of-the- basilar syndrome, with bilateral superior cerebellar artery infarctions. Cerebellar development at

micromolecular have also been studied. Ohyu and Takashima (1998) have studied the characteristics of neuronal nitric oxide synthase immunoreactive neurons in fetal brains. The need of the hour stimulated Meng, Oka and Takashima (1999) to study the developmental expression of monocyte chemoattractant protein-I in the human cerebellum and brainstem.Studies of Nualart, Godoy, Reinicke (1999) on the expression of the hexose transporters GLUT I and GLUT 2 during early development of human brain suggested that the cerebellum of the developing brain has the capacity to transport fructose, a substrate as a source of metabolic energy in foetal brain unlike adult brain.

## GRADING OF CEREBELLUM

A gradual change in ultrasound appearance of the fetal cerebellum is seen with advanced gestation. Kazumasa Hashimoto et al did a study to evaluate changes in cerebellum in advanced gestation by doing ultrasound for 291 normal fetuses of 14–41 wks gestational age [16-31].

**GRADE 1 ( upto 27 wks)**

a) each cerebellar hemisphere is round and

b) vermis has not developed well, which make the whole cerebellar appearance that of " pair of eye glasses" at ultrasound.

c) the hemispheres lack echogenicity.

Thus the cerebellum appears to be two fluid filled cysts.

**GRADE II ( 28 – 32 wks)**

a) The vermis can be seen more prominently and appears as echogenic rectangular tissue connecting the two hemispheres, which changes the whole cerebellar appearance of a " dumb bell" shape.

b) each hemisphere is oval, and the central portion is more echogenic than the peduncles and the other backround structures but less echogenic than vermis giving the internal portion a ground glass appearance.

**GRADE III ( after 32 wks)**

a) the appearance of the hemispheres changes to that of a triangular or " fan shaped" structure.

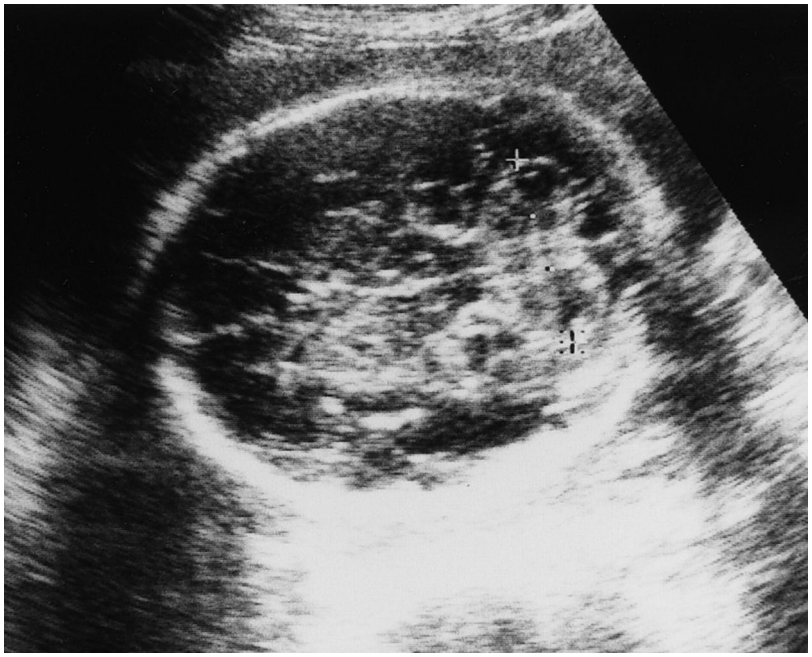
b) Tissues in the central portion of the hemispheres show similar echogenicity to that of the margin and the vermis giving the cerebellum more like a solid tissue than cyst.

There was a gradual and steady change in ultrasound appearance of fetal cerebellum like changes in both shape and echogenicity, appearance from an "**eye glass**" (grade I), to a "**dumb bell**" (grade II) and finally "**fan**" shape (grade III) with advancing gestation reflecting the histologic development [16-31] of the fetal cerebellum during pregnancy.

**Figure 1. Grade I cerebellum.**

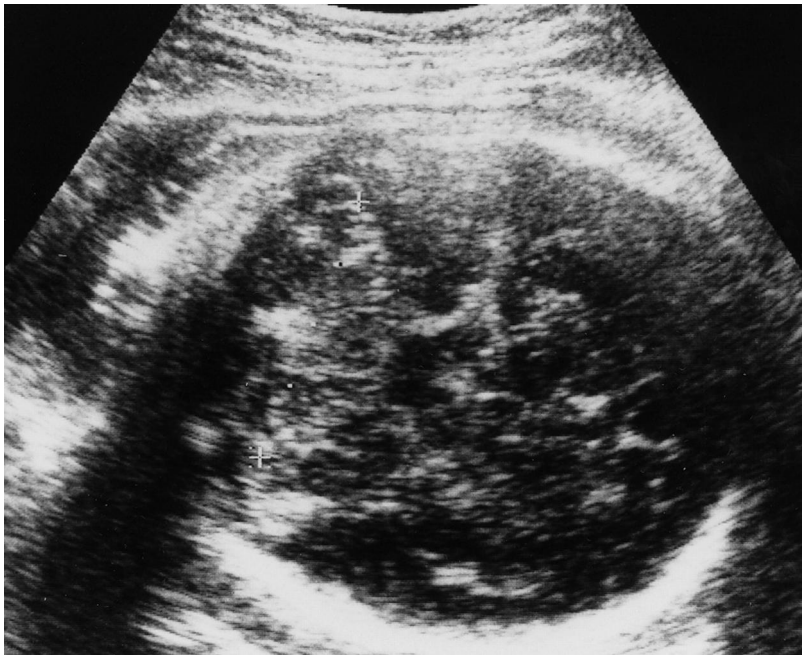
**Hashimoto K et al. Radiology 2001;221:70-74**

**Figure 2. Grade II cerebellum.**



**Hashimoto K et al. Radiology 2001;221:70-74**

**Figure 3. Grade III cerebellum.**



**Hashimoto K et al. Radiology 2001;221:70-74**

# BASIC PHYSICS OF ULTRASOUND

Diagnostic ultrasound which is a non-invasive imaging modality has tremendous impact in day to day management of patients. Most obstetric and gynaecological applications employ sonic frequencies between 2 – 3 Mhz. Ultrasound is defined as frequencies of sound waves above 20,000 cycles/sec (20KHz).

Three basic factors come into play in ultrasound viz., time, distance and velocity. Diagnostic ultrasound can be studied under three headings:

1) Production

2) Propagation

3) Display

## 1. PRODUCTION

Ultrasound is produced by a vibrating piezo-electric crystal.a synthetic crystal made of lead zirconate titanate is made to vibrate by applying a large voltage across the crystal.By alternately reversing the polarity and applying the voltage the crystal is made to expand and

contract the vibrations of the crystal produces compression and rarefaction of the air column in front of it.

These compressions and rarefactions produce mechanical pressure waves which are the ultrasound waves.

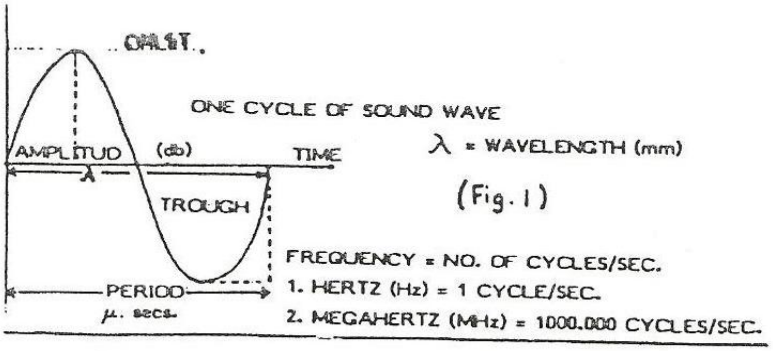
## INSTRUMENTATION

## ULTRASONIC TECHNIQUE :

1) **Pulsed echo technique –** provide the location of anatomic structure by measuring the transit time for sound to reach the structure and return to the ultrasonic detection. this is the technique applied in the equipment used in this study.

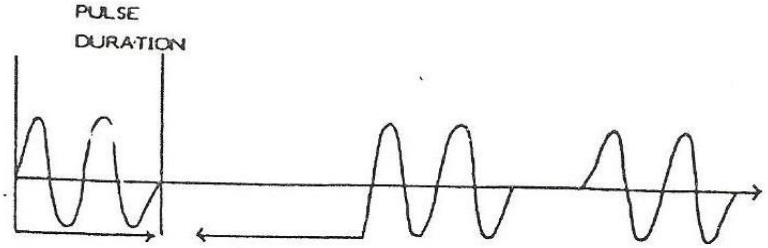
2) **Doppler technique –** frequency of returning echoes are analysed to determine the velocity of moving structure.

3) **Transmission techniques –** sound completely traversing the body is analysed for transit time, intensity, phase shift etc.

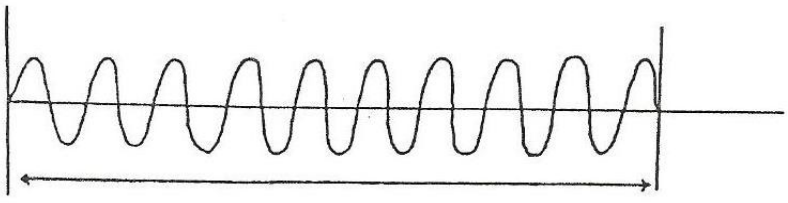



PULSED SOUND

PULSE = SHORT BURST OF SOUND WAVES
NO. OF PULSES/SEC. = PULSE REPETITION FREQUENCY (PRF)




CONTINUOUS SOUND
FREQUENCY NO. OF CYCLES/SEC.



## CONSTRUCTION OF A TRANSDUCER

The vibrations of the piezo-electric crystal produces ultrasound waves. For pulsed ultrasound the vibrations have to be controlled which is achieved by a process known as " damping".

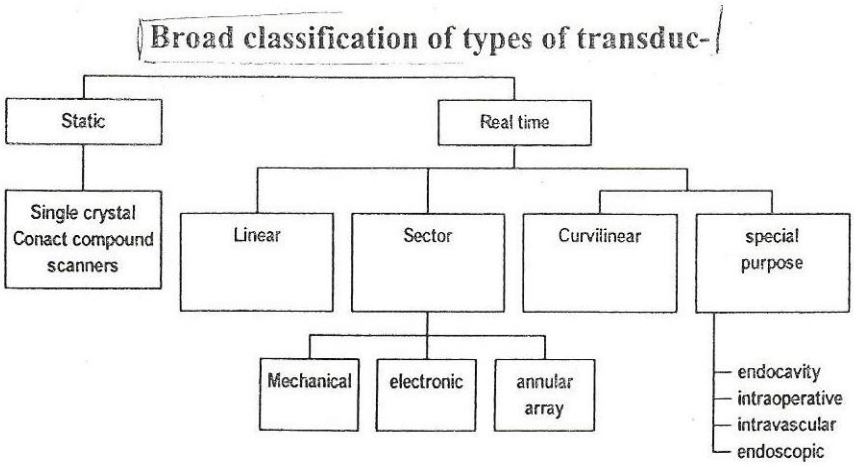
## TRANSDUCER TYPES

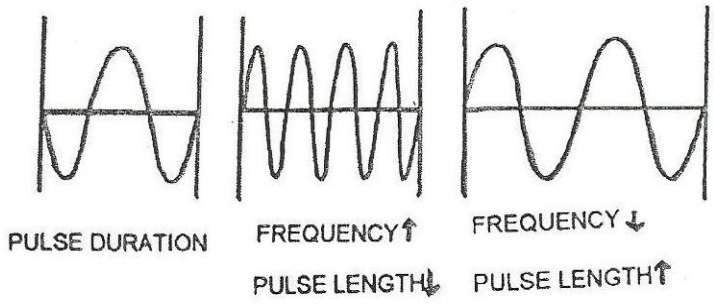
Nowadays we have transducers which can operate at different frequencies which resulted in improvement of image quality. For routine abdominal and obstetric ultrasound, a 3.5 – 5 MHz transducer is used. Low frequency transducers have better penetration with some loss of resolution and higher frequency transducers have better resolution with poorer penetration.

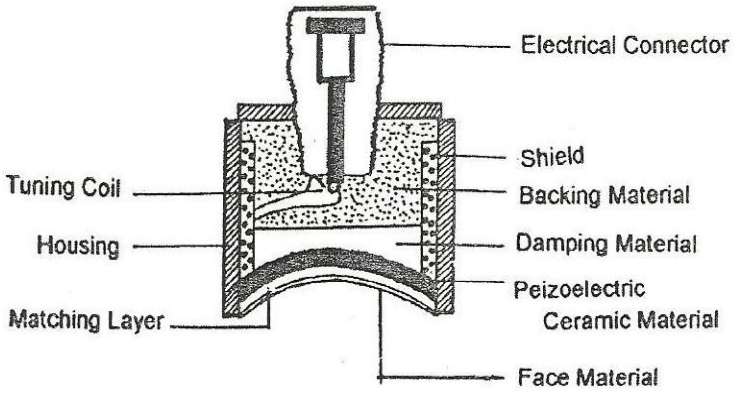
1. **LINEAR –** the transducer is large in size and image has a rectangular format used in general abdominal and obstetric imaging.

2. **SECTOR –** used for imaging brain through the fontanelle, cardiac imaging and for pelvic scans.

3. **CURVILINEAR –** produces a trapezoid shaped image.




COMPONENTS OF A TRANSDUCER

## 2. PROPAGATION

The ultrasound waves pass through tissue when the transducer, is placed on the body after applying a coupling gel. Sound waves are reflected at various tissue interfaces and these reflections return to the transducer as echoes.

## ACOUSTIC IMPEDANCE

Various tissues offer varying degrees of resistance to the passage of sound called acoustic impedance. The tissues commonly encountered in descending order of acoustic impedance are

a) air
b) bone
c) fat
d) soft tissue
e) fluid

Reflection is of two types – 1) specular
2) non - specular

## SCATTERING

Occurs when the beam encounters an interface that is irregular and smaller than the sound beam.

## REFRACTION AND DIFFRACTION

Cause decrease in the amplitude of returning echoes due to bending of sound beam.

## ATTENUATION

As propagation of ultrasound occurs occurs through tissue, the sound wave loses energy progressively. This not only occurs because of reflection but also due to absorption in the medium. The total loss of energy as sound passes through tissue is called attenuation. It depends on the frequency of the transducer and distance travelled by the sound beam.

## RESOLUTION

The two types are

a) ***Detail or linear*** – considered in 2 axes, axial /longitudinal and lateral / horizontal axis.

b) ***contrast or grey scale -*** Linear resolution – depends on the construction and frequency of the transducer. Higher the frequency, better is the axial resolution.

Contrast resolution – is the ability of the machine to depict echoes with small differences in amplitudes in different shades of grey.

## 3. DISPLAY

The reflected echoes may be displayed on screen as a useful image. These are the modes of display.

a) A mode

b)B mode

c)M mode

The reflected echoes are depicted as dots on the screen. Every reflection produces a single dot. The brightness of the dot depends on the intensity of the reflected echo. B mode is a two dimensional mode and 2 axes are depicted in any one section.

In longitudinal sections, antero-posterior and cephalocaudal axis is displayed. In transverse sections, antero-posterior and right-left or

lateral axis is displayed on the screen which gives two dimensional images in each section. By performing both longitudinal and transverse sections, we can create a three dimensional view of the organ and this helps in the better understanding of the anatomy.

**M MODE**

Motion display consists of B mode in which the baseline is continuously raised. Time-motion mode is a graphic representation of moving objects like the valves and the walls of the heart. M mode is very useful to study cardiac functions, as it is possible to obtain accurate measurements of the chambers and valve movements.

**REAL TIME**

It is a visual impression of motion seen on the screen. With this we can visualize movements of pulsating aorta, heartbeats, fetal movements etc.

**GRAY SCALING**

Refers to the depiction of echoes in various shades of gray according to the intensity of the reflected beam. It is a scale for quantification of echo signals to help in the interpretation of an US

image. The gray areas of varying intensity which are seen in between the white dots of light signify sonolucent areas. Equipments with 8, 16, 32 and 64 gray shades are available. The resolution of the image improves with increasing gray shadows.

# Materials and Methods

# MATERIAL AND METHODS

It is a prospective study conducted in Government RSRM Lying in Hospital attached to Stanley Medical College, Chennai between April 2010 to November 2010. A total of 204 antenatal women were included in the study belonging to second trimester. Women attending routine antenatal check up in the outpatient department and antenatal women admitted in the hospital were subjected to scan.

Those antenatal women with reliable dates as suggested by last menstrual period and clinical correlation and those with unknown dates were taken in the study. The study included both primi and mulitipara (15 – 24 weeks gestation) ,singleton or multipara and intrauterine growth retardation.

Mothers with gross obesity, medical complications like diabetes mellitus, hypertension, jaundice etc were excluded in this study. Foetuses with congenital anomalies and those who are not willing for study were excluded. No socio economic categorization was made.

A detailed history was elicited with special reference to the last menstrual period, its duration and amount and the regularity of the cycles. Then a thorough general, physical, systemic and obstetric examination were carried out. The women with reliable dates were scanned at Radiology department at Stanley Medical College, Chennai.

**MACHINE**

All examinations were performed using linear array real time B scanner with a 3.5 Mhz transducer.

**MEASUREMENT OF BIPARIETAL DIAMETER**

The first step is to understand the lie of the fetus which is done by identifying the head and spine during survey scan. The spine is the major land mark for identifying the lie of the fetus, the other anatomical parts of the body being traced in relation to the spine.

Step 1 A longitudinal section of the spine and head is taken to image the junction of the cervical spine and occiput.

Step 2 The probe is rotated transversely through 90. The coronal section of the head is imaged by this maneuver.

Step 3 The probe is made to slide forward along the parietal bone till a transverse view of the skull is obtained.

Step 4 The falx is imaged and with minimal rotatory & angulatory movements of the probe, the BPD plane identified. At this plane further adjustments of the transducer is done to obtain an oval shaped head.

The BPD plane is identified by visualizing the

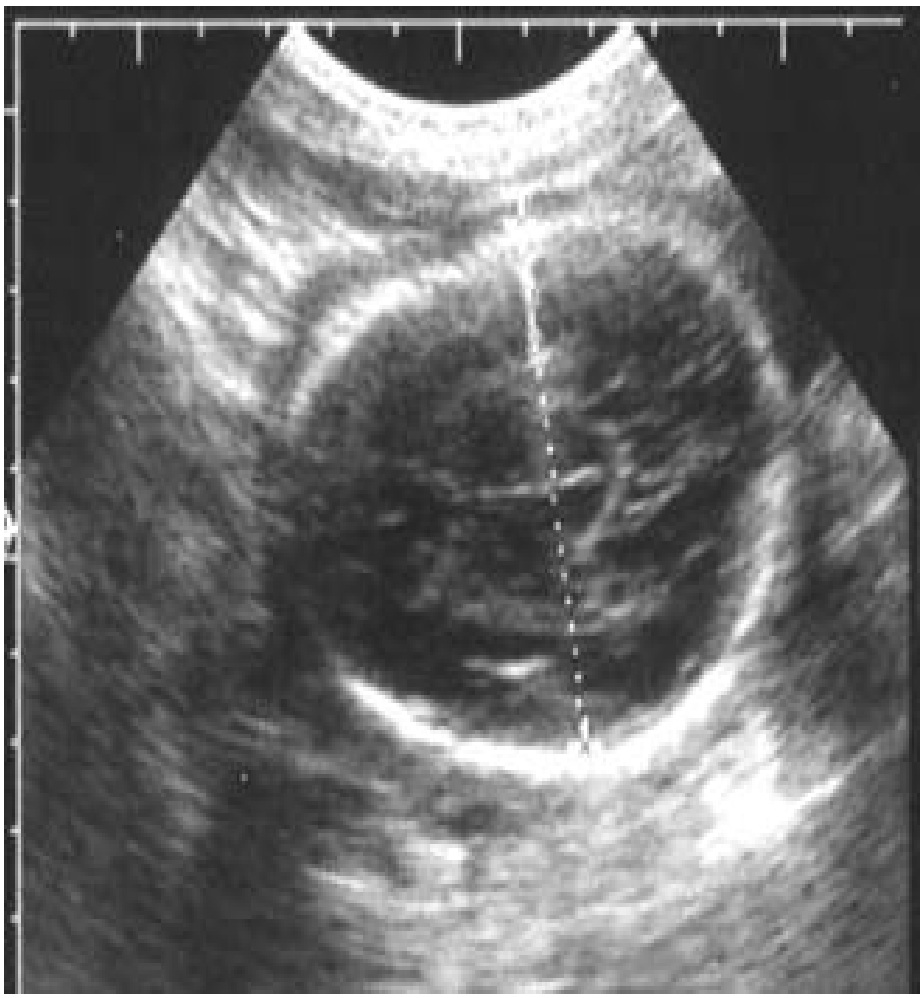
a) falx

b) cavum septum pellucidum

c) two triangular shaped thalami forming "**ARROW**" sign in the midline. The arrow points towards the occiput.

The biparietal diameter is the maximum diameter of the foetal skull at the level of the parietal eminences. It is measured from outer table of the proximal surface of the foetal skull to the inner table of the distal surface of the foetal skull at right angles to the midline and at the widest diameter.

# BIPARIETAL DIAMETER MEASUREMENT



**BPD 5.9 cm  GA 23 weeks 3 days.**

## MEASUREMENT OF TRANSVERSE CEREBELLAR DIAMETER

The level of scanning is first obtained as for measurement of the biparietal diameter. Slight rotation of the transducer to a plane approximately 30 degrees from Reids base line demonstrated the contents of the posterior fossa. In all cases, the widest diameter of the cerebellum was measured.

The three structures to be identified in the posterior fossa are:

1) Rounded cerebellar hemispheres ( dumb bell shaped)

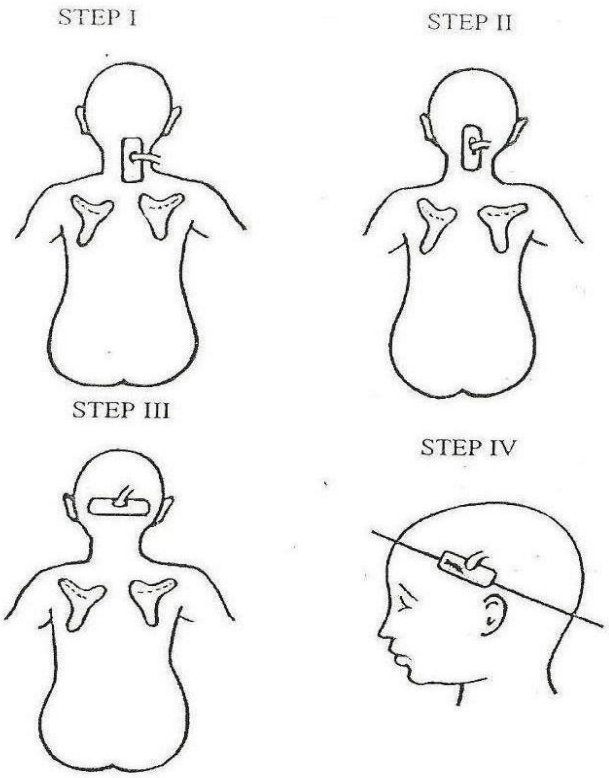
2) Vermis of the cerebellum. ( there should be no space in between the cerebellar hemispheres)

3) Cisterna magna ( seen as aclear space between the cerebellum and the occipital bone)

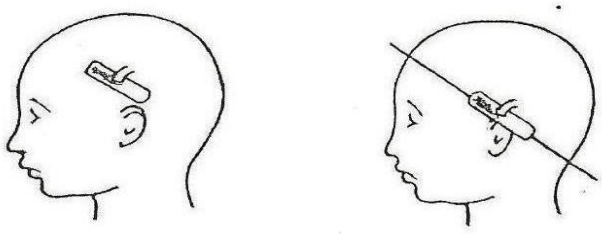
The transverse cerebellar plane imaging helps to exclude open neural defects with Arnold Chiari malformation in addition to a number of posterior fossa abnormalities. The nuchal fold thickness is measured from the occipital bone to the outer aspect of the skin at the level of the occipital bone. In the second trimester, the upper limit of

nuchal fold thickness is 6mm.those patients whose babies with posterior fossa anomalies and neural tube defects found incidentally while measuring transcerebellar diameter were excluded from the study.

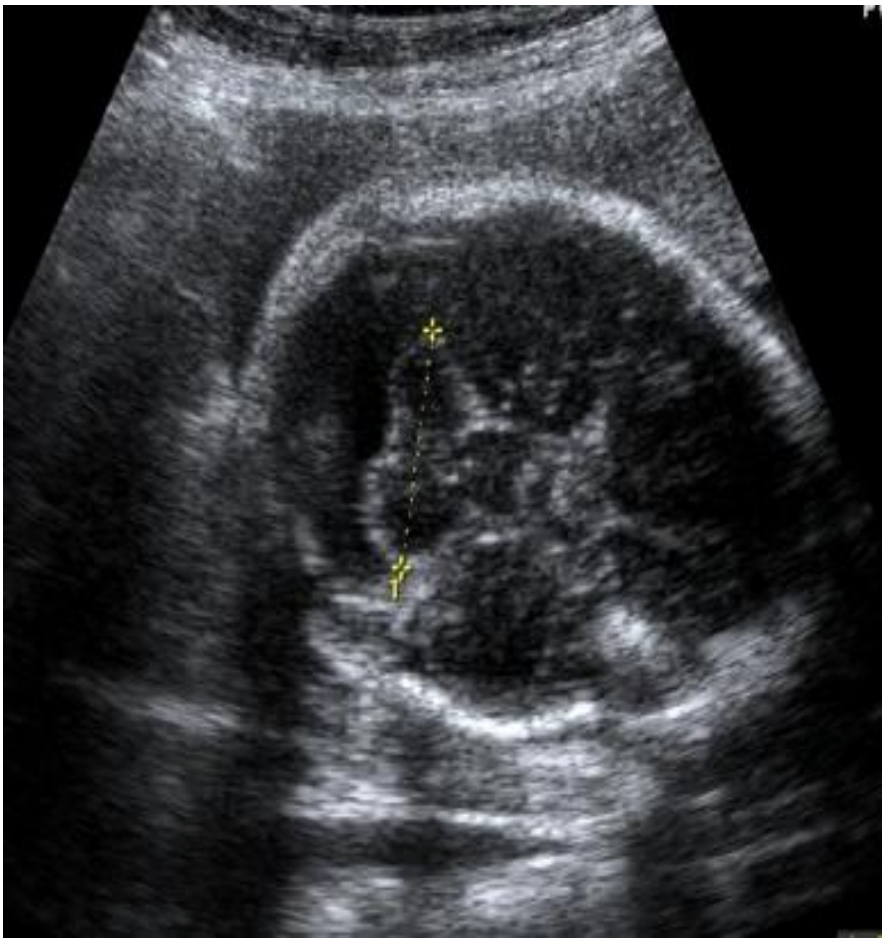
MEASUREMENT OF BIPARIETAL DIAMETER




MESUREMENT OF TRANSCEREBELLAR DIAMETER



# TRANSCEREBELLAR DIAMETER



**TCD 23 mm GA 23 weeks**

## MEASUREMENT OF FEMUR LENGTH

The entire femur length need not be measured. Only the ossified portions of the diaphysis and the metaphysis are measured. The ossified portion of the femur is more visible sonographically than the nonossified ends. Nonethless the cartilaginous ends are readily demonstrated. To obtain the measurement accurately, the transducer must be aligned to the long axis of the diaphysis.

## RULES FOR MEASURING FEMUR LENGTH [32]

1) align the transducer to the femur and freeze the plane that shows both the cartilaginous femoral head and distal condyle.

2) Place the measurement cursors at the junction of the cartilage and bone, being careful to avoid the distal femoral point.

# FEMUR LENGTH

**FL 28 mm GA  18 weeks**

# Results

## RESULTS

204 antenatal women with known and unknown dates were scanned in the present study.

## TABLE 1

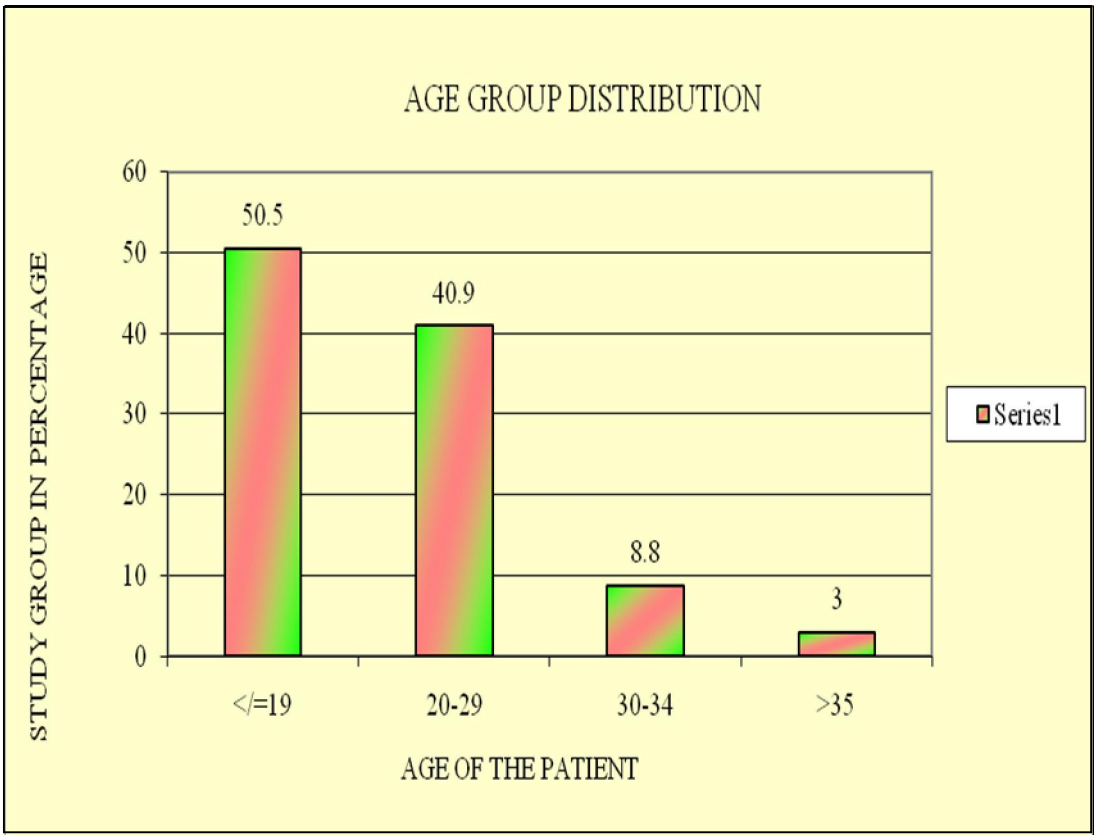
| AGE OF THE PATIENTS | NO OF CASES | STUDY GP IN PERCENTAGE |
|---|---|---|
| < / = 19 yrs | 99 | 50.05 |
| 20 - 29 | 80 | 40.09 |
| 30-34 | 18 | 8.8 |
| >35 | 7 | 3 |

The youngest patient in the present study was 18 years old and the eldest was 38 years.

.

**Chart – 1**

**Age Group Distribution**




| | | |
|---|---|---|
| Less than 19 Years | - | 50.05% |
| 20 to 29 Years | - | 40.09% |
| 30 to 34 Years | - | 8.8% |
| More than 35 Years | - | 3 % |

# TABLE 2

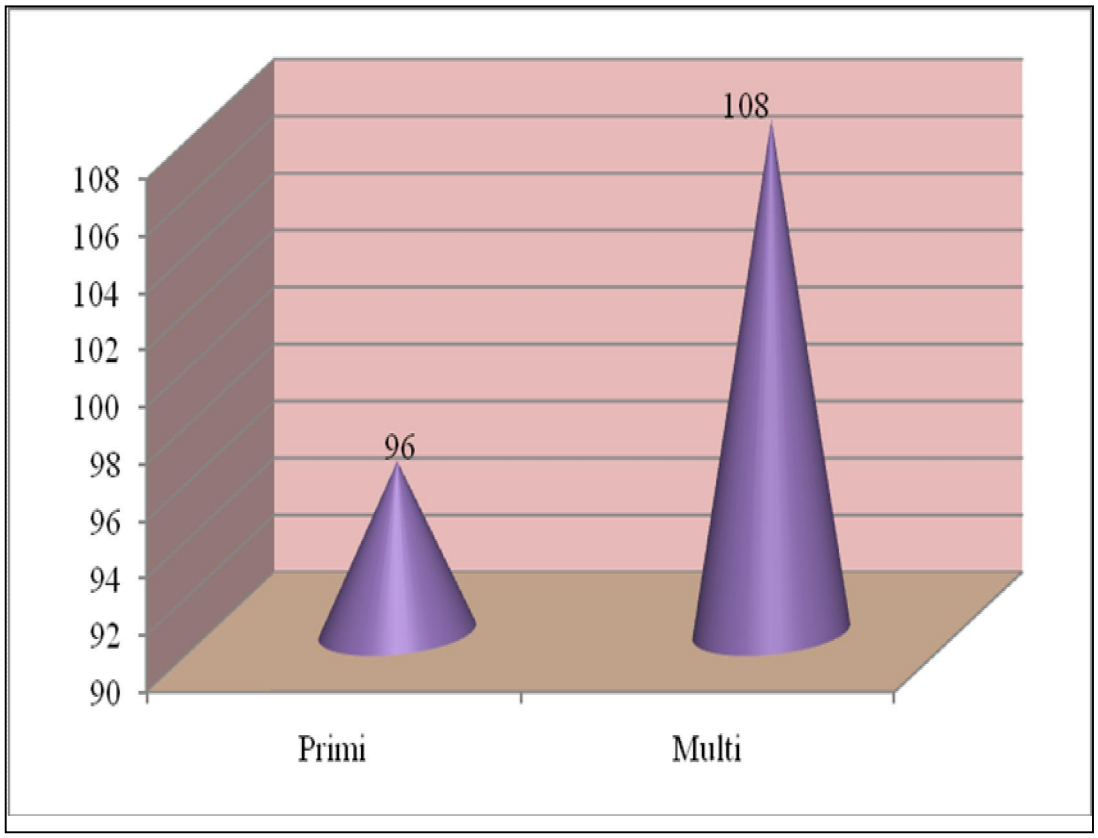
## STUDY GROUP IN RELATION TO PARITY

| PARITY | NO OF CASES | PERCENTAGE |
|---|---|---|
| PRIMI | 96 | 47.06 |
| MULTI | 108 | 52.94 |

This table shows the percentage of Primi and Multipara of 204 Patients in our study.

**Chart – 2**

**Study Group in Relation to Parity**




| | |
|---|---|
| Primi | 47.06 % |
| Multi | 52.94 % |

## TABLE 3

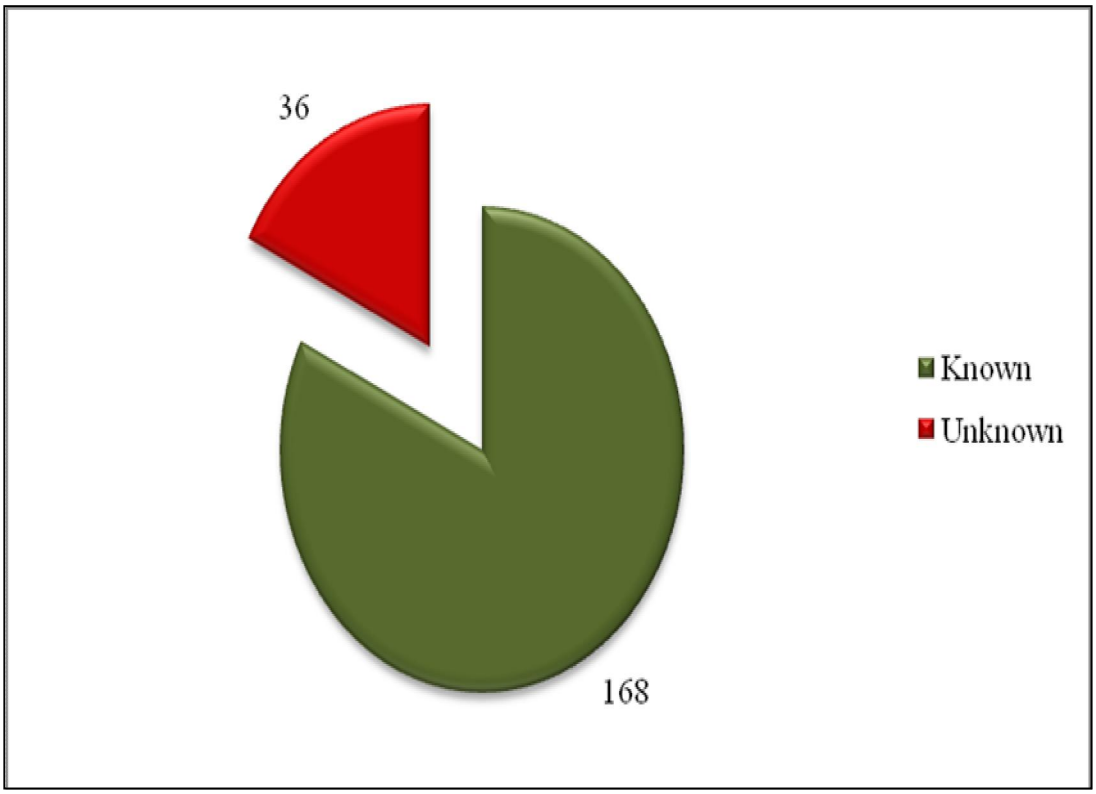
### TOTAL PATIENTS 204

| LMP | NO OF CASES | STUDY GP IN PERCENTAGE |
|---|---|---|
| Known | 168 | 82.35 |
| Unknown | 36 | 17.65 |

There were 168 patients with reliable dates as suggested by last menstrual period, clinical and ultrasound correlation and 36 patients with unknown dates in the present study.

**Chart – 3**

**Total Patients - 204**




Known LMP - 82.35%

Unknown LMP - 17.65%

## TABLE 4

| ORDER OF BABIES | NO | PERCENTAGE |
|---|---|---|
| Singleton | 198 | 97.06 |
| Multiple gestation | 6 | 2.94 |

There were 198 patients with singleton and 6 patients with multiple gestation. In our study TCD has no difference between singleton & Multiple gestation.

## TABLE 5

| SEX | NO OF NEW BORN | PERCENTAGE |
|---|---|---|
| BOY | 98 | 48.04 |
| GIRL | 106 | 51.96 |

There was no significant difference between TCD with respect to sex of the baby.

## TABLE 6

### TCD COMPARED WITH THE STANDARD NOMOGRAM

| GA( WKS) | TCD(MM) | STANDARD NOMOGRAM (HADLOCK) (MM) |
|---|---|---|
| 15 | 15 | 14 |
| 16 | 16 | 16 |
| 17 | 17 | 17 |
| 18 | 18 | 18 |
| 19 | 19 | 19 |
| 20 | 20 | 20 |
| 21 | 21 | 22 |
| 22 | 23 | 23 |
| 23 | 24 | 24 |
| 24 | 24 | 25 |

The above table gives the comparison of values of TCD in mm in our study with that of standard nomogram.

# TABLE 7

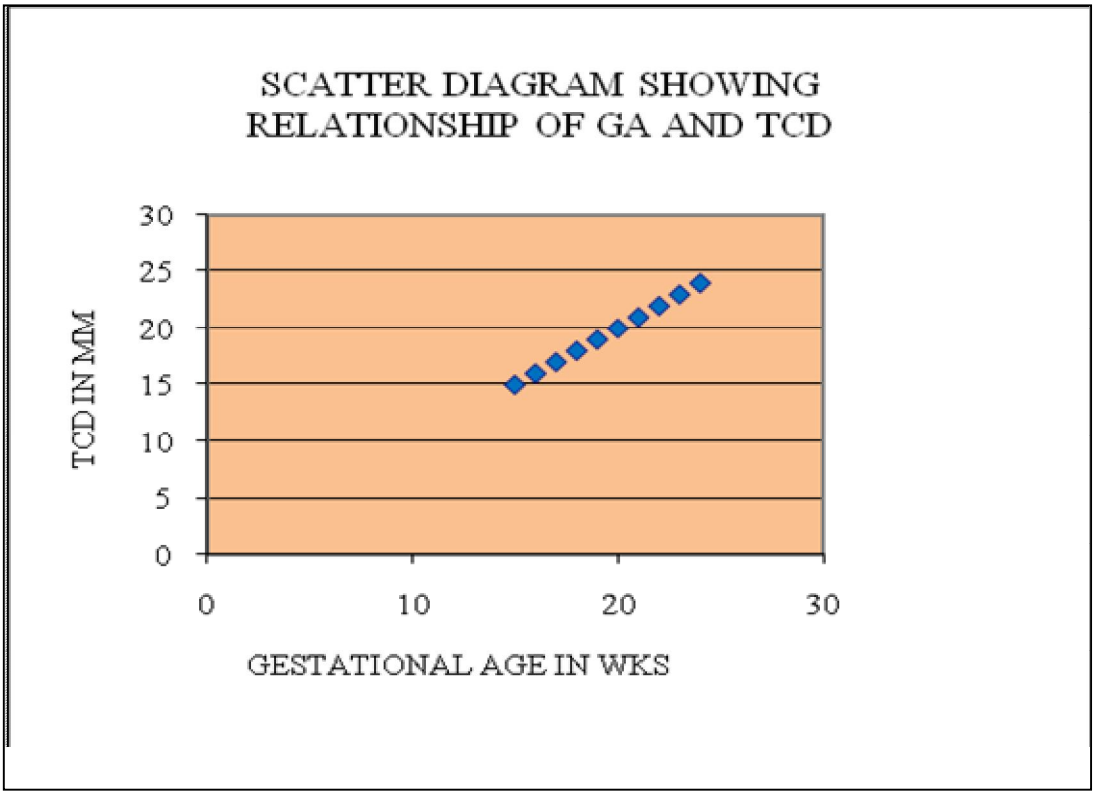
## TRANSVERSE CEREBELLAR DIAMETER

| GESTATIONAL AGE (weeks) | NO.OF PATIENTS | MEAN | STANDARD DEVIATION |
|---|---|---|---|
| 15 | 20 | 15.05 | 0.22 |
| 16 | 16 | 16.00 | 0.63 |
| 17 | 19 | 17.32 | 0.75 |
| 18 | 15 | 18.07 | 0.80 |
| 19 | 23 | 18.87 | 0.81 |
| 20 | 24 | 20.42 | 0.72 |
| 21 | 23 | 21.35 | 0.88 |
| 22 | 22 | 22.64 | 0.73 |
| 23 | 20 | 23.75 | 0.85 |
| 24 | 22 | 23.64 | 0.49 |

The above table gives mean and standard deviation of TCD for 204 patients of 15 to 24 weeks GA gestation.

**Chart – 4**

**Scatter Diagram showing the relationship of Gestational and Transcerebellar diameter.**




TCD Linearly Correlates with 15 – 24 weeks Gestational weeks

## TABLE 8

### BPD COMPARED WITH THE STANDARD NOMOGRAM

| GA (wks) | BPD (mm) | STANDARD NOMOGRAM (HAD LOCK) (mm) |
|---|---|---|
| 15 | 35 | 31 |
| 16 | 36 | 35 |
| 17 | 42 | 41 |
| 18 | 45 | 44 |
| 19 | 46 | 46 |
| 20 | 52 | 50 |
| 21 | 54 | 51 |
| 22 | 55 | 56 |
| 23 | 61 | 59 |
| 24 | 61 | 62 |

This table compares BPD in mm with standard nomogram for our 204 patients of 15 to 24 weeks GA.

## TABLE 9

### BIPARIETAL DIAMETER

| GA (wks) | NO. OF PATIENTS | MEAN | STANDARD DEVIATION |
|---|---|---|---|
| 15 | 20 | 34.80 | 1.40 |
| 16 | 16 | 37.00 | 1.86 |
| 17 | 19 | 41.16 | 2.03 |
| 18 | 15 | 44.93 | 1.22 |
| 19 | 23 | 46.17 | 1.59 |
| 20 | 24 | 51.17 | 1.86 |
| 21 | 23 | 54.87 | 2.20 |
| 22 | 22 | 54.55 | 2.56 |
| 23 | 20 | 60.70 | 2.49 |
| 24 | 22 | 60.95 | 1.65 |

This table gives the mean and standard deviation for BPD for 204 patients of 15 to 24 weeks GA.

# TABLE 10

## FEMUR LENGTH FL COMPARED WITH STANDARD NOMOGRAM

| GA (wks) | FL (mm) | Standard Nomogram (Hadlock) ( mm) |
|---|---|---|
| 15 | 20 | 18 |
| 16 | 21 | 21 |
| 17 | 24 | 25 |
| 18 | 26 | 28 |
| 19 | 30 | 31 |
| 20 | 33 | 34 |
| 21 | 36 | 35 |
| 22 | 38 | 39 |
| 23 | 39 | 42 |
| 24 | 43 | 44 |

This table compares FL in mm with the standard nomogram.

## TABLE 11

### FEMUR LENGTH

| GA ( wks ) | NO. OF PATIENTS | MEAN | S.D |
|---|---|---|---|
| 15 | 20 | 19.85 | 0.99 |
| 16 | 16 | 21.44 | 1.59 |
| 17 | 19 | 24.16 | 1.38 |
| 18 | 15 | 25.73 | 1.49 |
| 19 | 23 | 29.78 | 1.70 |
| 20 | 24 | 32.67 | 1.76 |
| 21 | 23 | 36.17 | 0.98 |
| 22 | 22 | 38.45 | 1.63 |
| 23 | 20 | 39.30 | 1.30 |
| 24 | 22 | 42.55 | 0.86 |

This table gives the mean and standard deviation for FL for 204 patients of 15 to 24 weeks GA.

## TABLE 12 : THE TRANSVERSE CEREBELLAR DIAMETER (TCD) DATA

| GA wks | N | This study mean | SD | SE | TCD centile | | | Estimated | P | MD | 95% CI of mean difference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 5 | 50 | 95 | | | | Lower limit | Upper limit |
| 15 | 20 | 15.05 | 0.22 | 0.05 | 15 | 15 | 16 | 15 | 0.33 | 0.05 | -0.05 | 0.15 |
| 16 | 16 | 16.00 | 0.63 | 0.16 | 15 | 16 | 17 | 16 | 1.0 | 0.00 | -0.34 | 0.34 |
| 17 | 19 | 17.32 | 0.75 | 0.17 | 16 | 17 | 18 | 17 | 0.83 | 0.32 | -0.05 | 0.68 |
| 18 | 15 | 18.07 | 0.80 | 0.21 | 16 | 18 | 19 | 18 | 0.75 | 0.07 | -0.38 | 0.51 |
| 19 | 23 | 18.87 | 0.81 | 0.17 | 17 | 19 | 21 | 19 | 0.45 | -.0.13 | -0.48 | 0.22 |
| 20 | 24 | 20.42 | 0.72 | 0.15 | 20 | 20 | 22 | 20 | .009 | 0.42 | 0.11 | 0.72 |
| 21 | 23 | 21.35 | 0.88 | 0.18 | 20 | 21 | 23 | 22 | .002 | -0.65 | -1.03 | -0.27 |
| 22 | 22 | 22.64 | 0.73 | 0.15 | 22 | 22 | 24 | 23 | .029 | 0.36 | -1.03 | -0.27 |
| 23 | 20 | 23.75 | 0.85 | 0.19 | 23 | 23 | 25 | 24 | .204 | -.0.25 | -0.65 | 0.15 |
| 24 | 22 | 23.64 | 0.49 | 0.10 | 23 | 24 | 24 | 25 | .000 | -1.36 | -1.58 | -1.15 |

T test P value < o.oo1** correlation is significant at the 0.01 level (2 tailed).

## TABLE 13 : THE BIPARIETAL DIAMETER (BPD) DATA

| GA wks | N | This study mean | SD | SE | TCD centile | | | Estimated | P | MD | 95% CI of mean difference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 5 | 50 | 95 | | | | Lower limit | Upper limit |
| 15 | 20 | 34.80 | 1.40 | 0.31 | 32 | 35 | 36.95 | 31 | 0.000 | 3.8 | 3.15 | 4.45 |
| 16 | 16 | 37.00 | 1.86 | 0.47 | 35 | 36 | 37 | 35 | 0.001 | 2.0 | 1.01 | 2.99 |
| 17 | 19 | 41.16 | 2.03 | 0.47 | 36 | 42 | 43 | 41 | 0.739 | 0.16 | -0.82 | 1.14 |
| 18 | 15 | 44.93 | 1.22 | 0.32 | 43 | 45 | 46 | 44 | 0.010 | 0.93 | 0.26 | 1.61 |
| 19 | 23 | 46.17 | 1.59 | 0.33 | 44 | 46 | 48 | 46 | 0.604 | 0.17 | -0.51 | 0.86 |
| 20 | 24 | 51.17 | 1.86 | 0.38 | 48 | 52 | 53.75 | 50 | 0.005 | 1.17 | 0.38 | 1.95 |
| 21 | 23 | 54.87 | 2.20 | 0.46 | 50.2 | 54 | 58.00 | 51 | 0.000 | 3.87 | 2.92 | 4.82 |
| 22 | 22 | 54.55 | 2.56 | 0.55 | 51 | 55 | 60 | 56 | 0.014 | -1.45 | -2.59 | -0.32 |
| 23 | 20 | 60.70 | 2.49 | 0.56 | 56 | 61 | 64 | 59 | 0.007 | 1.7 | 0.53 | 2.87 |
| 24 | 22 | 60.95 | 1.65 | 0.35 | 58 | 61 | 63 | 62 | 0.007 | -1.05 | -1.78 | -0.32 |

T test P value < o.oo1** correlation is significant at the 0.01 level (2 tailed).

## TABLE 14 : THE FEMUR LENGTH (FL) IN MM DATA

| GA wks | N | This study mean | SD | SE | TCD centile | | | Estimated | P | MD | 95% CI of mean difference | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 5 | 50 | 95 | | | | Lower limit | Upper limit |
| 15 | 20 | 19.85 | 0.99 | 0.22 | 18 | 19 | 21 | 18 | 0.000 | 1.85 | 1.39 | 2.31 |
| 16 | 16 | 21.44 | 1.59 | 0.40 | 20 | 21 | 22 | 21 | 0.289 | 0.44 | -0.41 | 1.28 |
| 17 | 19 | 24.16 | 1.38 | 0.32 | 22 | 25 | 24 | 25 | 0.016 | -0.84 | -1.51 | -0.17 |
| 18 | 15 | 25.73 | 1.49 | 0.38 | 24 | 28 | 28 | 28 | 0.000 | -2.27 | -3.09 | -1.44 |
| 19 | 23 | 29.78 | 1.70 | 0.36 | 28 | 31 | 33.8 | 311 | 0.002 | 1.22 | 1.95 | -0.48 |
| 20 | 24 | 32.67 | 1.76 | 0.36 | 29 | 34 | 35 | 34 | 0.001 | -1.33 | -2.08 | -0.59 |
| 21 | 23 | 36.17 | 0.98 | 0.21 | 35 | 38 | 386 | 35 | 0.000 | 1.17 | 0.75 | 1.60 |
| 22 | 22 | 38.45 | 1.63 | 0.35 | 36 | 38 | 41 | 39 | 0.130 | -0.55 | -1.27 | 0.18 |
| 23 | 20 | 39.30 | 1.3 | 0.29 | 38 | 42 | 42 | 42 | 0.000 | -2.70 | -3.31 | -2.09 |
| 24 | 22 | 42.55 | 0.86 | 0.18 | 41 | 44 | 44 | 44 | 0.000 | -1.45 | -1.83 | -1.07 |

T test P value < o.oo1** correlation is significant at the 0.01 level (2 tailed).

# TABLE 15

## CORRELATION TABLE

| | | |
|---|---|---|
| TCD | Pearson correlation Sig (2 tailed) N | 0.96** |
| BPD | Pearson correlation Sig (2 tailed) N | 0.95** |
| FL | Pearson correlation Sig (2 tailed) N | 0.94** |

** Correlation is significant at the 0.01 level (2 tailed)

# TABLE 16

## REGRESSION EQUATIONS DERIVED FROM STUDY

## FOR PREDICTING TCD FROM GA

| | | $R^2$ Value (%) |
|---|---|---|
| TCD | -0.2630 + 1.0243 (Age) | 93% |
| TCD | -5.8763 + 1.6117 (Age) - 0.0150 $(age)^2$ | 93% |
| TCD | -4.2930 + 1.3418 (Age) - 0.0001 $(age)^2$ – 0.0003 $(age)^3$ | 93% |

## TABLE 17

## COMPARISON OF CURRENT STUDY WITH ESTABLISHED TCD NOMOGRAMS BY GA

| TCD 50th Percentile (mm) | Predicted GA (Week) | | | | | |
|---|---|---|---|---|---|---|
| | Current Study | Chavez | Goldstein | Altman | Snijders | Hill |
| 15 | 15 | 15 | 15 | 16 | 15 | 15 |
| 16 | 16 | 16 | 16 | 17 | 16 | 16 |
| 17 | 17 | 17 | 17 | 18 | 17 | 17 |
| 18 | 18 | 18 | 18 | 19 | 18 | 18 |
| 19 | 19 | 19 | 19 | 20 | 19 | 19 |
| 20 | 20 | 20 | 20 | 21 | 19 | 19 |
| 21 | 21 | 21 | 21 | 21 | 19 | 21 |
| 22 | 22 | 21 | 21 | 22 | 21 | 21 |
| 23 | 23 | 22 | 22 | 23 | 21 | 21 |
| 24 | 24 | 23 | 23 | 24 | 22 | 22 |

**This table compares the TCD value in mm of our study with studies done previously.**

# Discussion

# DISCUSSION

There were 204 patients that met inclusion criteria for this study .TCD measurements for gestational ages from 15 – 24 weeks were done. With the use of regression equation, the predicted TCD for the $5^{th}$, $50^{th}$ and $95^{th}$ centiles were calculated for each GA.

Regression analysis focuses on the form of the relationship between variables , while the objective of correlation analysis is to gain insight into the strength of the relationship. Coefficient of determination ( $R^2$) is the fraction of variability in percentage that can be explained by the variability in x through their linear relationship or vice versa. ( Table 16).

Transcerebellar diameter shows linear correlation with advancing fetal age. The collected data was converted into variables and analysed. Predicted values were obtained for antenatal patients of RSRM in our study by using the regression equation. (Table 17).

**PREDICTED TCD for 204 patients**

| GESTATIONAL AGE | TCD |
|---|---|
| 15 | 15 |
| 16 | 16 |
| 17 | 17 |
| 18 | 18 |
| 19 | 19 |
| 20 | 20 |
| 21 | 22 |
| 22 | 23 |
| 23 | 24 |
| 24 | 25 |

Sonographic sizes of the cerebellum increased linearly during the second trimester.

The difference in millimeters of our measurements for each gestational age was compared with data from other nomograms [33 -38] (Table 18 ). Gestational age and TCD 50$^{th}$ percentile in mm correlated well till 24 weeks of gestation.

# Summary

# SUMMARY

204 antenatal women with reliable dates were scanned in the present study belonging to second trimester. Women attending routine antenatal check up in the outpatient department and antenatal women admitted in the hospital were subjected to scan. It is a prospective study conducted between **April 2010 to November 2010**.

Antenatal women in the present study were seen from 15 weeks onwards because it has been reported that the folia of the vermis develops by 13 weeks and the lamella are seen only after 15 weeks.

Ultrasonography plays a central role in modern obstetric practice and that ultrasonographic examination should be recommended when indicated and performed with womens' s consent. Most would agree that there are advantages to routine obstetric ultrasonographic examinations done once, at about 18 weeks.

Campbell et al established that ultrasonographic measurement of GA between 12 – 18 weeks is superior to an optimal menstrual history in predicting the date of delivery.

The American Institute of Ultrasound in Medicine assessed theoretical harms in its safety assessment and concluded that "**the benefits to the patients of the prudent use of diagnostic ultrasound far outweighs any potential risk**" [39].

There was a similar rate of growth in singleton and multifetal gestations. The transverse cerebellar diameter therefore represents an independent biometric parameter that can be used in both singleton and multifetal pregnancies to assess normal and deviant fetal growth [40].

Chavez, M.R. et al conducted a study to construct an institution specific transverse cerebellar diameter nomogram and to compare its ability to predict GA with previously published nomograms. They suggested that institutions performing large numbers of fetal ultrasound examinations should derive TCD nomograms and perhaps nomograms for other fetal biometry for their own populaions to deterkmine the measurement standards most appropriate for clinical use. The specific TCD nomogram chosen for clinical application should be based on rigorous methods and large samples from populations that are as homogenous as possible.

The differences with other nomograms may be due to the differences in the sample size, unselected population, large number of third trimester fetuses, recent technological advancements in ultrasound and ethnic population variation. Similarity that of Goldstein may be due to similar sample size and distribution.

# Conclusion

# CONCLUSION

1. The transcerebellar diameter significantly correlates with gestational age.

2. The transcerebellar diameter is a useful biometric parameter in estimating gestational age in the second trimester.

3. The transcerebellar diameter represents an independent biometric parameter that can be used in both singleton and multifetal pregnancies to asses normal and deviant fetal growth.

4. This method helps in the compulsory visualisation of the posterior cranial fossa and the cerebellum thereby facilitating better diagnosis of open neural defects.

5. Transcerebellar diameter measurements had a similar relationship with gestational age across previously published nomograms before 28 weeks.

6. Transcerebellar diameter has high predictive accuracy compared with other parameters for assessing gestational age.

7. It is very useful if a patient with unknown dates came for first booking visit in second trimester for assessing the exact gestational age.

8. Transcerebellar diameter is reliable, cost effective and time saving.

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# Annexures

# PROFORMA

NAME:

SOCIO ECONOMIC CLASS:

PARITY:

LMP:

MENSTRUAL HISTORY:

OBSTETRIC HISTORY:

DATE OF QUICKENING:

O/E:- Ht: Wt: B.p:

URINE PREGNANCY TEST:

EARLY SCANS:

INVESTIGATIONS:

Hb:

Urine albumin:

sugar:

Blood group & Rh typing:

**USG** – BPD :

FL :

TCD ( Transcerebellar diameter) :

## Pearson's Correlation Coefficient

**Pearson's correlation coefficient** is also known as Karl Pearson's correlation coefficient. Pearson's correlation coefficient is the method of measuring the correlation. This method was developed by Karl Pearson and is therefore named Pearson's correlation coefficient. Pearson's correlation coefficient is known as the best method of measuring the correlation, because it is based on the method of covariance. Pearson's correlation coefficient gives information about the degree of correlation as well as the direction of the correlation.

**Assumptions in calculating the Pearson's correlation coefficient:**

1. **Independent of case:** In Pearson's correlation of coefficient, cases should be independent to each other.
2. **Distribution:** In Pearson's correlation coefficient, variables of the correlation should be normally distributed.
3. **Cause and effect relationship:** In Pearson's correlation coefficient, there should be a cause and effect relationship between the correlation variables.
4. **Linear relationship:** In Pearson's correlation coefficient, two variables should be linearly related to each other, or if we plot the value of variables on a scatter diagram, it should yield a straight line.

**Properties in Pearson's correlation coefficient:**

The following are the properties of Pearson's correlation coefficient:

1. **Limit of the Pearson correlation coefficient:** Karl Pearson's correlation coefficient value lies between +1 to -1.

2. **Pure number:** Pearson's correlation coefficient is a pure number and it is independent of the unit of measurement. For example, if one

   variable's unit of measurement is in inches and the second variable is in quintals, even then, Pearson's correlation coefficient value does not change.

3. **Symmetric:** Pearson's correlation of the coefficient between two variables is symmetric. This means that if we calculate the Pearson's correlation coefficient between X and Y or Y and X, the value of Pearson's correlation coefficient will remain the same.

**Probable error and Karl Pearson's correlation coefficient:**

Probable error is used to determine the reliability of Pearson's correlation coefficient. The following formula is used to determine the value of probable error:

$$r^2 P.E. = 0.6745 \frac{1-}{\sqrt{N}}$$

- Where:
- P.E = Probable error
- $x$ — Pearson's correlation coefficient
- N = Number of observations
- If the absolute value of Pearson's correlation coefficient is greater than 6 times probable error, then the Pearson's correlation-coefficient is taken to be significant. If the absolute value of Pearson's correlation coefficient is less than 6 times probable error, then the correlation coefficient will be insignificant.

## DEGREE OF CORRELATION:

1. **Perfect correlation:** If Pearson's correlation coefficient value is near ± 1,thenit said to be a perfect correlation.
2. **High degree of correlation:** If Pearson's correlation coefficient value lies between ± 0.75 and ± 1, then it is said to be a high degree of correlation.
3. **Moderate degree of correlation:** If Pearson's correlation coefficient value lies between ±0.25 and ± 0.75, then it is said to be moderate degree of correlation.
4. **Low degree of correlation:** When Pearson's correlation coefficient value lies between 0 and ± 0.25, then it is said to be a low degree of correlation.
5. **No correlation:** When Pearson's correlation coefficient value lies around zero, then there is no correlation.

# ABBREVIATIONS

| | | | |
|---|---|---|---|
| 1. | GA | - | Gestational age |
| 2. | BPD | - | Biparietal diameter |
| 3. | FL | - | Femur length |
| 4. | AC | - | Abdominal circumference |
| 5. | HC | - | Head circumference |
| 6. | TCD | - | Transcerebellar diameter |
| 7. | IUGR | - | Intra uterine growth retardation |
| 8. | SGA | - | Small for gestational age |
| 9. | LGA | - | Large for gestational age |
| 10. | MHz | - | Mega hertz |
| 11. | LMP | - | Last Menstrual period |
| 12. | EDD | - | Expected Date of Delivery |
| 13. | SD | - | Standard Deviation |
| 14. | SE | - | Standard Error |
| 15. | MD | - | Mean Difference |
| 16. | CI | - | Confidence Interval |

# Master Chart

# MASTER CHART

| Sl. No. | Name | Age | Gravida | LMP | EDD | BPD (mm) | FL (mm) | TCD (mm) | GA wks |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Asiya | 18 | primi | 2/02/10 | 7/11/10 | 37 | 19 | 15 | 15 |
| 2 | Banu | 18 | primi | 4/02/10 | 9/11/10 | 35 | 21 | 15 | 15 |
| 3 | Meharunisha | 18 | Primi | 6/2/10 | 11/11/10 | 32 | 18 | 15 | 15 |
| 4 | Veeramani | 18 | G2A1 | **Unknown** | | 33 | 18 | 15 | 15 |
| 5 | Ponnammal | 18 | G2P1L1 | 8/2/10 | 13/11/10 | 34 | 19 | 15 | 15 |
| 6 | Mahazebir | 18 | G2P1L1 | **Unknown** | | 35 | 20 | 15 | 15 |
| 7 | Latha | 18 | G2A1 | 20/02/10 | 25/11/10 | 36 | 21 | 15 | 15 |
| 8 | Jeyalakshmi | 18 | G2P1L1 | **Unknown** | | 32 | 20 | 15 | 15 |
| 9 | Kanimozhi | 18 | G2A1 | 25/02/10 | 30/11/10 | 33 | 20 | 15 | 15 |
| 10 | Nirmala | 18 | G2A1 | 26/02/10 | 01/12/10 | 34 | 20 | 15 | 15 |
| 11 | Kalaraja | 30 | G2P1L1 | 28/02/10 | 03/12/10 | 35 | 19 | 15 | 15 |
| 12 | Ranganayaki | 30 | G2A1 | 06/03/10 | 13/12/10 | 36 | 19 | 15 | 15 |
| 13 | Latha | 30 | G2P1L1 | 09/03/10 | 16/12/10 | 35 | 20 | 15 | 15 |
| 14 | Uma | 20 | Primi | 12/03/10 | 19/12/10 | 36 | 21 | 15 | 15 |
| 15 | Uleera begum | 21 | Primi | 15/03/10 | 22/12/10 | 36 | 19 | 16 | 15 |
| 16 | Hemamalini | 20 | Primi | 18/03/10 | 25/12/10 | 35 | 20 | 15 | 15 |
| 17 | Kutty | 25 | Primi | 20/03/10 | 27/12/10 | 35 | 21 | 15 | 15 |
| 18 | Sathapriya | 27 | Primi | 20/03/10 | 27/12/10 | 36 | 20 | 14 | 15 |
| 19 | Banu | 23 | Primi | 25/03/10 | 02/01/11 | 36 | 21 | 15 | 15 |
| 20 | Meena | 24 | Primi | 26/03/10 | 03/01/11 | 35 | 21 | 15 | 15 |
| 21 | Amudha | 19 | G2P1L1 | **Unknown** | | 38 | 21 | 17 | 16 |
| 22 | Kalairani | 19 | G2P1L1 | 28/03/10 | 05/01/11 | 36 | 21 | 15 | 16 |
| 23 | Ramani | 19 | G2P1L1 | 30/03/10 | 07/01/11 | 35 | 24 | 17 | 16 |
| 24 | Premavathy | 19 | G2P1L1 | 02/03/10 | 10/01/11 | 35 | 20 | 17 | 16 |
| 25 | Geetha | 30 | G2P1L1 | 18/01/10 | 25/10/10 | 40 | 21 | 16 | 16 |
| 26 | Swarnalakshmi | 30 | G2A1 | 19/01/10 | 26/10/10 | 36 | 24 | 16 | 16 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 27 | Ayesha | 30 | G2P1L1 | 22/01/10 | 29/10/10 | 36 | 21 | 16 | 16 |
| 28 | Parvathy | 19 | G2A1 | 25/01/10 | 01/11/10 | 38 | 24 | 16 | 16 |
| 29 | Rajalakshmi | 19 | G2A1 | **Unknown** | | 40 | 20 | 16 | 16 |
| 30 | Habeebunisha | 19 | G2P1L1 | 30/01/10 | 06/11/10 | 35 | 24 | 15 | 16 |
| 31 | Kala | 23 | Primi | 31/01/10 | 07/11/10 | 35 | 21 | 16 | 16 |
| 32 | Vijayalakshmi | 24 | Primi | 03/02/10 | 10/11/10 | 36 | 21 | 16 | 16 |
| 33 | Kalaiselvi | 25 | Primi | 08/02/10 | 15/11/10 | 38 | 20 | 16 | 16 |
| 34 | Eswari | 24 | Primi | **Unknown** | | 38 | 20 | 15 | 16 |
| 35 | Kalyani | 26 | primi | 06/03/10 | 13/12/10 | 40 | 20 | 16 | 16 |
| 36 | Anu | 30 | G2P1L1 | 28/01/10 | 04/11/10 | 36 | 21 | 16 | 16 |
| 37 | Hema | 18 | Primi | 06/04/10 | 13/01/11 | 40 | 24 | 18 | 17 |
| 38 | Buela | 18 | Primi | 08/04/10 | 15/01/10 | 42 | 24 | 18 | 17 |
| 39 | Saritha | 18 | Primi | 11/02/10 | 18/11/10 | 40 | 22 | 16 | 17 |
| 40 | Latha | 18 | Primi | 06/03/10 | 13/12/10 | 40 | 25 | 17 | 17 |
| 41 | Pappu | 18 | Primi | 07/02/10 | 14/11/10 | 42 | 25 | 19 | 17 |
| 42 | Agasthya | 18 | G2P1L1 | **Unknown** | | 44 | 24 | 17 | 17 |
| 43 | Eswari | 18 | G2A1 | 28/01/10 | 04/11/10 | 42 | 22 | 17 | 17 |
| 44 | Selvi | 18 | G2P1L1 | 10/04/10 | 17/01/11 | 40 | 26 | 18 | 17 |
| 45 | Tamilarasi | 18 | G2P1L1 | 12/04/10 | 19/01/10 | 42 | 26 | 18 | 17 |
| 46 | Chithra | 18 | G2P1L1 | 16/03/10 | 23/12/10 | 42 | 24 | 18 | 17 |
| 47 | Muniammal | 18 | G2A1 | 06/04/10 | 13/01/11 | 42 | 24 | 17 | 17 |
| 48 | Sasikala | 23 | G2A1 | 25/01/10 | 01/11/10 | 44 | 25 | 17 | 17 |
| 49 | Kalavathy | 25 | G2A1 | **Unknown** | | 40 | 26 | 17 | 17 |
| 50 | Chandra | 28 | G2A1 | 22/01/10 | 27/11/10 | 42 | 24 | 17 | 17 |
| 51 | Kamatchi | 28 | G2P1L1 | 24/01/10 | 29/11/10 | 38 | 22 | 17 | 17 |
| 52 | Ramani | 29 | G2A1 | **Unknown** | | 36 | 22 | 16 | 17 |
| 53 | Wahitha | 26 | G2P1L1 | 07/04/10 | 14/01/11 | 40 | 24 | 17 | 17 |
| 54 | Chithra | 25 | G3P1L1A1 | 09/04/10 | 16/01/11 | 44 | 26 | 18 | 17 |
| 55 | Ramalakshmi | 27 | G2P1L1 | 05/04/10 | 12/01/11 | 42 | 24 | 17 | 17 |
| 56 | Rajeshwari | 18 | Primi | 08/02/10 | 15/11/10 | 45 | 27 | 19 | 18 |
| 57 | Bhuvana | 18 | primi | 10/02/10 | 17/11/10 | 47 | 26 | 18 | 18 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 58 | Meenakshi | 18 | Primi | 01/04/10 | 08/01/11 | 44 | 24 | 18 | 18 |
| 59 | Meena | 18 | Primi | **Unknown** | | 43 | 29 | 18 | 18 |
| 60 | Padma | 18 | Primi | 25/01/10 | 01/11/10 | 44 | 27 | 18 | 18 |
| 61 | Gayathri | 28 | G2A1 | 28/01/10 | 04/11/10 | 44 | 26 | 17 | 18 |
| 62 | Usha | 27 | G2A1 | **Unknown** | | 45 | 27 | 18 | 18 |
| 63 | Sujatha | 31 | G2P1L1 | 18/01/10 | 25/11/10 | 45 | 24 | 19 | 18 |
| 64 | neethu | 31 | G3P1L1A1 | 24/02/10 | 03/11/10 | 47 | 24 | 18 | 18 |
| 65 | Sarala | 31 | G2P1L1 | **Unknown** | | 45 | 24 | 18 | 18 |
| 66 | Bharathy | 27 | G2A1 | 28/04/10 | 08/03/11 | 44 | 26 | 18 | 18 |
| 67 | Rajakumari | 25 | Primi | 29/05/10 | 08/03/01 | 44 | 26 | 19 | 18 |
| 68 | Sulochana | 25 | Primi | 30/05/10 | 09/03/11 | 45 | 26 | 19 | 18 |
| 69 | Latha | 29 | Primi | 28/04/10 | 05/01/11 | 47 | 24 | 18 | 18 |
| 70 | Manjula | 28 | Primi | **Unknown** | | 45 | 26 | 18 | 18 |
| 71 | Devi | 18 | Primi | 02/03/10 | 09/12/10 | 48 | 34 | 20 | 19 |
| 72 | Chandra | 18 | Primi | 19/12/10 | 26/09/10 | 44 | 30 | 19 | 19 |
| 73 | Sujatha | 18 | Priimi | 13/01/10 | 20/10/10 | 47 | 29 | 20 | 19 |
| 74 | Selvi | 18 | G2A1 | 26/12/10 | 03/10/10 | 46 | 33 | 19 | 19 |
| 75 | Zeenath | 18 | G3P1L1A1 | 20/01/10 | 27/10/10 | 48 | 29 | 19 | 19 |
| 76 | Zuliha | 18 | G2P1L1 | **Unknown** | | 44 | 29 | 21 | 19 |
| 77 | Priya | 28 | G2P1L1 | 28/01/10 | 04/11/10 | 45 | 31 | 17 | 19 |
| 78 | Priya | 18 | G2A1 | 30/01/10 | 06/11/10 | 48 | 31 | 18 | 19 |
| 79 | Tahira | 29 | G2P1L1 | 20/02/10 | 25/11/10 | 44 | 31 | 19 | 19 |
| 80 | Rajalakshmi | 28 | G2P1L1 | 22/02/10 | 27/11/10 | 46 | 28 | 19 | 19 |
| 81 | Padmini | 29 | G2A1 | 07/02/10 | 14/11/10 | 48 | 29 | 19 | 19 |
| 82 | Sundari | 28 | Primi | 09/02/10 | 16/11/10 | 44 | 28 | 19 | 19 |
| 83 | Shameem | 29 | Primi | 10/02/10 | 17/11/10 | 48 | 29 | 18 | 19 |
| 84 | Leena | 28 | Primi | 13/02/10 | 20/11/10 | 47 | 29 | 19 | 19 |
| 85 | Ramani | 25 | Primi | 15/02/10 | 22/11/10 | 46 | 29 | 19 | 19 |
| 86 | Priya | 28 | Primi | **Unknown** | | 48 | 28 | 19 | 19 |
| 87 | Vimala | 25 | Primi | 18/02/10 | 25/11/10 | 44 | 28 | 19 | 19 |
| 88 | Vanaja | 29 | Primi | 15/05/10 | 22/02/11 | 46 | 30 | 18 | 19 |
| 89 | Anitha | 28 | Primi | 09/01/10 | 16/10/10 | 46 | 30 | 18 | 19 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 90 | Prabha | 29 | Primi | 09/01/10 | 16/10/10 | 46 | 30 | 18 | 19 |
| 91 | Veerama | 28 | Primi | 24/01/10 | 31/10/10 | 47 | 28 | 19 | 19 |
| 92 | Malathi | 26 | Primi | 12/02/10 | 19/11/10 | 48 | 29 | 19 | 19 |
| 93 | Mohana | 27 | G2P1L1 | **Unknown** | | 46 | 33 | 19 | 19 |
| 94 | Rani | 18 | Primi | 07/02/10 | 14/11/10 | 48 | 33 | 20 | 20 |
| 95 | Geetha | 18 | Primi | 19/02/10 | 26/11/10 | 50 | 32 | 20 | 20 |
| 96 | Sudha | 18 | Primi | 20/02/10 | 27/11/10 | 52 | 32 | 20 | 20 |
| 97 | Ranju | 18 | Primi | **Unknown** | | 53 | 32 | 18 | 20 |
| 98 | Vaishnavi | 18 | Primi | 09/01/10 | 16/10/10 | 49 | 33 | 20 | 20 |
| 99 | Rajeshwari | 18 | Primi | 20/01/10 | 27/10/10 | 48 | 32 | 20 | 20 |
| 100 | Vanitha | 18 | Primi | 22/01/10 | 29/10/10 | 52 | 29 | 20 | 20 |
| 101 | Jeya | 18 | Primi | 24/01/10 | 31/10/10 | 51 | 34 | 22 | 20 |
| 102 | Julie | 18 | Primi | 12/0210 | 19/11/10 | 53 | 35 | 20 | 20 |
| 103 | Lalitha | 18 | Primi | **Unknown** | | 54 | 34 | 20 | 20 |
| 104 | Pavithra | 28 | G2A1 | 19/02/10 | 26/11/10 | 53 | 32 | 21 | 20 |
| 105 | Sheela | 28 | G2P1L1 | 21/02/10 | 28/11/10 | 52 | 33 | 20 | 20 |
| 106 | Kala | 29 | G2P1L1 | 24/01/10 | 19/10/10 | 53 | 29 | 22 | 20 |
| 107 | Sharmila | 29 | G2P1L1 | 26/01/10 | 21/10/10 | 51 | 32 | 20 | 20 |
| 108 | Rajeshwari | 28 | G2P1L1 | 04/01/10 | 11/10/10 | 51 | 36 | 21 | 20 |
| 109 | Girija | 28 | G3P1L1A1 | 06/01/10 | 13/10/10 | 52 | 37 | 21 | 20 |
| 110 | Muniammal | 27 | G2A1 | **Unknown** | | 52 | 37 | 22 | 20 |
| 111 | Jannath | 25 | G2P1L1 | **Unknown** | | 50 | 35 | 20 | 20 |
| 112 | Sandya | 26 | G2A1 | 17/03/10 | 24/12/10 | 49 | 35 | 21 | 20 |
| 113 | Muthulakshmi | 26 | GIP1L1 | 20/03/10 | 27/12/10 | 49 | 35 | 21 | 20 |
| 114 | Basanthi | 27 | Primi | 09/01/10 | 16/10/10 | 49 | 33 | 21 | 20 |
| 115 | Jeyanthi | 26 | Primi | 04/01/10 | 11/10/10 | 48 | 34 | 20 | 20 |
| 116 | Padmasri | 26 | Primi | 05/01/10 | 12/10/10 | 52 | 32 | 22 | 20 |
| 117 | Sivagami | 27 | Primi | 18/03/10 | 25/12/10 | 53 | 29 | 20 | 20 |
| 118 | Lalitha | 19 | Primi | 20/03/10 | 27/12/10 | 56 | 36 | 21 | 21 |
| 119 | Sarala | 19 | Primi | 03/05/10 | 10/02/11 | 57 | 37 | 21 | 21 |
| 120 | Sultana | 20 | Primi | **Unknown** | | 53 | 37 | 22 | 21 |
| 121 | Subha | 23 | Primi | 20/01/10 | 27/10/10 | 51 | 36 | 21 | 21 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 122 | Shanthi | 24 | Primi | 21/01/10 | 28/10/10 | 54 | 35 | 20 | 21 |
| 123 | Gowri | 25 | Primi | 23/10/10 | 30/10/10 | 56 | 35 | 21 | 21 |
| 124 | Selvi | 19 | Primi | 08/02/10 | 15/11/10 | 58 | 35 | 22 | 21 |
| 125 | Thamaraiselvi | 34 | G2P1L1 | 10/02/10 | 17/11/10 | 54 | 37 | 19 | 21 |
| 126 | Sankari | 34 | G2P1L1 | 09/02/10 | 16/11/10 | 53 | 36 | 22 | 21 |
| 127 | Uma | 19 | G2A1 | **Unknown** | | 53 | 36 | 21 | 21 |
| 128 | Kala | 19 | G2P1L1 | 18/02/10 | 25/11/10 | 54 | 36 | 22 | 21 |
| 129 | Logambal | 20 | G2A1 | 20/02/10 | 27/11/10 | 57 | 35 | 22 | 21 |
| 130 | Rajeshwari | 25 | Primi | **Unknown** | | 58 | 35 | 21 | 21 |
| 131 | Dhanakodi | 21 | Primi | 25/10/10 | 01/11/10 | 54 | 36 | 23 | 21 |
| 132 | Vanaja | 25 | Primi | 27/10/10 | 03/11/10 | 56 | 36 | 22 | 21 |
| 133 | Merlin | 26 | Primi | 28/10/10 | 04/11/10 | 56 | 39 | 22 | 21 |
| 134 | Nirmala | 27 | Primi | **Unknown** | | 53 | 37 | 21 | 21 |
| 135 | Vijaya | 26 | Primi | 02/03/10 | 09/12/10 | 54 | 36 | 22 | 21 |
| 136 | Munilakshmi | 26 | Primi | 04/03/10 | 11/12/10 | 56 | 37 | 23 | 21 |
| 137 | Gowri | 25 | Primi | 28/01/10 | 05/10/10 | 54 | 36 | 20 | 21 |
| 138 | Deviselvam | 26 | Primi | 22/01/10 | 29/10/10 | 58 | 37 | 18 | 21 |
| 139 | Nagarathinam | 28 | Primi | 24/01/10 | 31/10/10 | 57 | 37 | 21 | 21 |
| 140 | Jeyalakshmi | 28 | Primi | 26/01/10 | 02/11/10 | 56 | 39 | 22 | 21 |
| 141 | Elizebeth | 18 | G3P1L1A1 | **Unknown** | | 51 | 39 | 22 | 22 |
| 142 | Vijaya | 18 | G2P1L1 | 24/02/10 | 01/12/10 | 55 | 36 | 24 | 22 |
| 143 | Chihra | 18 | G2P1L1 | 17/01/10 | 24/10/10 | 57 | 39 | 22 | 22 |
| 144 | Kalavathy | 18 | G2P1L1 | 19/01/10 | 26/10/10 | 53 | 38 | 23 | 22 |
| 145 | Mala | 18 | G2A1 | 29/01/10 | 06/10/10 | 52 | 36 | 23 | 22 |
| 146 | selvi | 18 | G3P1L1A1 | 18/04/10 | 25/01/11 | 55 | 36 | 23 | 22 |
| 147 | Anandalaxmi | 18 | G3P1L1A1 | **unknown** | | 60 | 41 | 24 | 22 |
| 148 | Bhuvana | 18 | G2P1L1 | 07/01/10 | 25/01/11 | 51 | 40 | 23 | 22 |
| 149 | Malliga | 18 | Primi | 09/01/10 | 27/01/11 | 53 | 38 | 22 | 22 |
| 150 | Poongulali | 18 | Primi | 10/01/10 | 28/10/11 | 53 | 38 | 23 | 22 |
| 151 | Poongodi | 27 | Primi | 29/12/10 | 06/10/11 | 53 | 36 | 22 | 22 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 152 | Clara | 28 | Primi | 30/12/09 | 07/10/10 | 56 | 36 | 23 | 22 |
| 153 | Sahedabegum | 32 | Primi | 31/12/09 | 08/10/10 | 55 | 39 | 23 | 22 |
| 154 | Rani | 31 | Primi | 01/01/10 | 09/10/10 | 53 | 40 | 24 | 22 |
| 155 | Amudha | 30 | Primi | 15/12/09 | 22/09/10 | 51 | 40 | 23 | 22 |
| 156 | Zenifer | 31 | G2P1L1 | 03/03/10 | 10/12/10 | 55 | 38 | 23 | 22 |
| 157 | Meera | 32 | G3P1L1A1 | 29/12/09 | 06/10/10 | 53 | 39 | 24 | 22 |
| 158 | Lakshmi | 33 | G2P1L1 | 10/01/10 | 17/10/10 | 60 | 38 | 22 | 22 |
| 159 | Prabavathy | 32 | G3P1L1A1 | 18/04/10 | 25/01/11 | 56 | 41 | 22 | 22 |
| 160 | Neelavathy | 31 | G2P1L1 | 20/04/10 | 27/01/11 | 56 | 40 | 23 | 22 |
| 161 | Usha sekar | 30 | G2P1L1 | 14/01/10 | 21/10/10 | 57 | 39 | 22 | 22 |
| 162 | Chithra | 37 | G2A1 | 16/01/10 | 23/10/10 | 55 | 39 | 22 | 22 |
| 163 | Revathy | 18 | Primi | 18/01/10 | 25/10/10 | 64 | 41 | 24 | 23 |
| 164 | Maria | 18 | Primi | 10/01/10 | 17/10/10 | 63 | 39 | 24 | 23 |
| 165 | Megalamani | 18 | Primi | **Unknown** | | 63 | 39 | 24 | 23 |
| 166 | Sathyabama | 18 | G3P1L1A1 | 28/12/09 | 04/10/10 | 64 | 38 | 24 | 23 |
| 167 | Mariammal | 18 | G2A1 | 30/12/09 | 06/10/10 | 63 | 38 | 23 | 23 |
| 168 | Sudha | 18 | G2P1L1 | 10/01/10 | 17/10/10 | 58 | 40 | 25 | 23 |
| 169 | Indira | 18 | G3P1L1A1 | 12/01/10 | 19/10/10 | 57 | 38 | 23 | 23 |
| 170 | Pushpa | 31 | G2A1 | 20/01/10 | 27/10/10 | 58 | 40 | 25 | 23 |
| 171 | Devi | 30 | G2P1L1 | **Unknown** | | 56 | 38 | 23 | 23 |
| 172 | Latha | 31 | G2P1L1 | 22/01/10 | 29/10/10 | 58 | 39 | 24 | 23 |
| 173 | Nandhini | 30 | Primi | 03/12/10 | 10/09/10 | 59 | 38 | 23 | 23 |
| 174 | Amudha | 32 | Primi | 03/01/10 | 10/10/10 | 60 | 40 | 19 | 23 |
| 175 | katheeja | 33 | Primi | 05/01/10 | 12/10/10 | 63 | 40 | 18 | 23 |
| 176 | Nirmala | 32 | Primi | 28/11/09 | 04/09/10 | 60 | 42 | 25 | 23 |
| 177 | Nagarani**(TW INS)** | 38 | G2P1L1 | 30/11/09 | 06/09/10 | 62 | 38 | 25 | 23 |
| 178 | Nagammal | 31 | Primi | 29/11/09 | 05/09/10 | 60 | 39 | 25 | 23 |
| 179 | Sridevi | 27 | G3P1L1A1 | **Unknown** | | 63 | 38 | 23 | 23 |
| 180 | Selvi | 26 | G2A1 | 06/01/09 | 13/09/10 | 62 | 39 | 23 | 23 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 181 | Usha**(TWINS)** | 28 | G2A1 | 28/11/09 | 04/09/10 | 62 | 40 | 23 | 23 |
| 182 | Sailaxmi | 27 | G2A1 | 22/01/10 | 29/10/10 | 59 | 42 | 23 | 23 |
| 183 | Dhanam | 37 | G3P1L1A1 | 02/01/10 | 09/10/10 | 61 | 44 | 23 | 24 |
| 184 | Panchu | 25 | G2P1L1 | Unknown | | 62 | 41 | 23 | 24 |
| 185 | Zuleka bee | 24 | G2P1L1 | 04/02/10 | 11/11/10 | 62 | 42 | 22 | 24 |
| 186 | Poongodi | 18 | G2A1 | 14/02/10 | 21/11/10 | 62 | 43 | 23 | 24 |
| 187 | Vijayalakshmi | 18 | G2P1L1 | 15/02/10 | 22/11/10 | 62 | 43 | 22 | 24 |
| 188 | Thilagam | 18 | G3P1L1A1 | 02/01/10 | 09/10/10 | 61 | 43 | 24 | 24 |
| 189 | Kannagi**(TWINS)** | 26 | G2P1L1 | 04/01/10 | 11/10/10 | 58 | 42 | 24 | 24 |
| 190 | Abitha | 37 | G2P1L1 | **Unknown** | | 63 | 42 | 23 | 24 |
| 191 | Jeyanthi | 25 | Primi | 05/02/10 | 12/11/10 | 63 | 43 | 24 | 24 |
| 192 | Malliga | 26 | Primi | 06/03/10 | 13/12/10 | 63 | 43 | 24 | 24 |
| 193 | Shamshath | 36 | Primi | 09/03/10 | 16/12/10 | 62 | 42 | 24 | 24 |
| 194 | Saraswathi | 29 | G2P1L1 | 09/03/10 | 16/12/10 | 60 | 42 | 24 | 24 |
| 195 | Kamala | 36 | G2A1 | **Unknown** | | 60 | 44 | 24 | 24 |
| 196 | Vasanthi**(TWINS)** | 28 | G2P1L1 | 16/04/10 | 23/01/11 | 58 | 44 | 24 | 24 |
| 197 | Selvarani | 28 | G2A1 | 18/04/10 | 25/01/11 | 58 | 42 | 24 | 24 |
| 198 | Mala | 36 | G2P1L1 | 18/04/10 | 25/01/11 | 59 | 42 | 23 | 24 |
| 199 | Rosemary | 18 | Primi | 11/02/10 | 18/11/10 | 60 | 43 | 24 | 24 |
| 200 | Geetha | 18 | Primi | 12/02/10 | 19/11/10 | 61 | 43 | 24 | 24 |
| 201 | Lakshmi | 18 | Primi | 16/02/10 | 23/11/10 | 61 | 42 | 24 | 24 |
| 202 | Seetha | 26 | G2P1L1 | 20/02/10 | 27/11/10 | 62 | 42 | 24 | 24 |
| 203 | Laxmi**(TWINS)** | 35 | G2P1L1 | **Unknown** | | 63 | 43 | 23 | 24 |
| 204 | Gowri | 25 | G2P1L1 | 16/12/09 | 23/01/11 | 60 | 41 | 24 | 24 |